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Need for Balanced Research in Different Fields of Biology Stressed

40081071a Beijing KEYAN GUANLI [SCIENCE AND RESEARCH MANAGEMENT] in Chinese
No 1, Jan 88 pp 13-16

[Article by Song Zhenneng [1345 2182 5174], Biology and Technology Bureau, Chinese Academy of Sciences: "Coordinated Development of the Country's Biology Endeavors"]

[Text] The policy of "priority development of the critical fields at the leading edge of biology in China while also developing other fields of biology" serves as a guide in this article, which emphasizes exploration of various problems needing attention in the country's current handling of the inter-relationship among related branches of biology, including the relationship of biological engineering to other major branches of biology, and how to regard and deal with the relationship between key fields for priority development in biology and ordinary fields of biology.

An overall survey of the whole situation in biology shows that priority impetus to the fields on the leading edge of biology accompanied by appropriate development of ordinary biology, as well as timely study to solve problems that arise in the process of moving ahead holds major significance for the healthy and coordinated development of the country's biology and the job of applying and developing it.

The newly emerging leading edge fields of learning in the natural sciences and technology can produce more wideranging and far reaching effects on social productivity and the development of science than the ordinary fields of biology. As a result, they receive special attention and support from the government and from leading edge science and technology units in all countries. They also attract extremely great attention on the part of the rank and file engaged in scientific and technical work, and the public in general. This is entirely natural and also completely as it should be. Successful biological engineering experiments begun during the late 1970's on growth hormone release of suppresser factor somatotatin, and on insulin propelled biology into a new stage in which the directed transformation and creation of organisms in predictable ways began to be possible. The rise and vigorous development of biological engineering centering around gene engineering will result in changes of a fundamental nature for economics, sociology, and related disciplines. Not long ago protein engineering, which is even newer than gene engineering, appeared, and even though it is still in the

exploratory stage, the brand new magnificent prospect of mankind being able to modify and transform the subtle structure of organisms has appeared. This situation has caused the governments of numerous countries in the world as well as large numbers of capitalist firms in capitalist countries to hurry to invest in, to take various other measures, and to bend every effort to promote biological engineering research, development and production. China has also formulated a quick response. It has designated biological engineering an important leading edge field in science and technology, and it has actively intensified research and applied development work in all aspects of biological engineering.

In addition to biological engineering, China's science and technology policy making organs have selected another four new leading edge fields in biology following discussions and nominations by numerous biologists. These four fields, which are based on the trend of development in biology internationally and needs in building China's national economy and developing its society, have been termed the "four pillars" of biology. They are molecular biology, cytobiology, neurobiology, and ecology, and they are the key fields of learning that are to be highlighted. They have been recommended for priority development in the expectation that they will spur a rise in the level of all biology, and that they will provide leaders and theoreticians for the development of the country's new biological engineering industries, and will perform other major construction tasks related to biology in the country.

Thanks to the serious attention given by the state, the support of various quarters, and the efforts of the rank and file engaged in scientific and technical work, varying degrees of progress has been made during the past several years in these leading edge fields of learning. In particular, rapid advances in biological engineering have produced heartening achievements. Of course, much future work remains to be done in order to give more effective impetus to the development of these leading edge fields of learning. In the remainder of this article, I would like to raise some problems requiring serious attention that are based on the superficial knowledge I have gained from my personal work in this regard.

1. Better Coordination of the Development of New leading Edge Fields of Learning

In the past, it was entirely correct to have placed biological engineering in the most prominent position and to have given it full support. The problem is that in the corresponding development of other leading edge fields of learning, some fields did not receive enough support. An example is neurobiology, which is one of the most active fields of biology today, and which is regarded as being the next high peak in the development of biology after molecular biology, yet it has yet to receive the support it should have.

Following reform of the science and technology system, it was only natural that all units engaged in biological research and all scientific and technical workers should strive to get funds through various channels. It should be realized, however, that the four fields, one of which is molecular biology,

are different in nature than biological engineering. The work of a basic nature that they do in the fields of basic research and applied research accounts forms a substantial percentage of all scientific research work. A small amount of the research work done in these fields receives funding to set up open laboratories, but scientific research funds for a good deal of other work is often less than in the ordinary fields of biology where possibilities for application and development are strong. Unless providing needed support is considered in policy terms for the development of various disciplines, these new leading edge fields will not be able to get priority development. There is also work like setting up stations at fixed locations in the field ecosystem as part of ecological studies that requires the coordination of many disciplines, and also requires a long period of field observation and the accumulation of experimental data before ecological studies can play a guiding role in production. Only if receipt of a fixed amount of money can be assured each year will it be possible for research work to continue for a long period of time. If funds are cut off, the stations at fixed locations that have been built over the years will be wiped out instantly, and the results obtained through hard work on the part of scientists will be thrown aside. This would be very bad for the country.

2. Prevention of the Tendency to "Rush Headlong Into Mass Action"

Several times in the course of China's development of biology, there has been a "headlong rush into mass action." When a certain new field of research or a field of research considered to be "hot" suddenly appeared or was slightly encouraged, every part of the country rushed to get into it without doing any overall planning or examining it carefully. Numerous scientific research units established research teams hurriedly, and laboratories, or even research institutes and institutions of higher learning followed suit by setting up special departments, or they had large numbers of scientists abandon the work they had been doing to work on the new field of research. But not long afterward, for various reasons known to all such as incomplete planning, insufficient state funds, or lack of people qualified to do the research, there was a great "headlong rush away". We should not forget these lessons of history.

During the past several years, this same tendency has begun to appear again with regard to biological engineering, and it is rather conspicuous in certain other fields of scientific research as well. In the culturing and rapid reproduction of plant tissue, for example, personnel in numerous units having to do with botany, agricultural science and forestry science are engaged in this kind of research. In the field of botany alone, this involves personnel in many specialities including cytology, morphology, physiology, genetic breeding, cultivation, and the introduction and taming of wild plants. During the Cultural Revolution period, there was a national craze for research on anther culturing and haploid breeding. According to statistics, 5,000 people in 1,000 units were engaged in this work, and today probably no fewer than this number is engaged in tissue culturing and quick reproduction. The result of such a "headlong rush into mass action" is the large scale duplication of work at a low level and the waste of much manpower and financial resources.

Conversely, few people or no one is looking into quite a few other aspects of these same specialities; thus new gaps are being created that cause a lopsided development of the field.

The organization and concentration of fairly large numbers of people to do work, a proper augmentation or establishment of new research, development and teaching units for the purpose of intensifying biological engineering research and development, and the training of talent is normal and necessary. However, to permit uncontrolled development in the absence of directed overall planning and without insuring that commensurate actions are taken might lead down the same old disastrous historical road causing losses for national reconstruction and the development of science and technology.

3. Serious Attention to Strengthening Weak Links and Filling Voids

Basic work and the building of downstream technology in biological engineering has received considerable attention in recent years. As a result, some weak links have been strengthened and some voids filled. Examples include the establishment of gene banks and cell banks, isolation of target genes, analysis of the structure of nucleotides, research and development of bioreactors, etc. Of course, work in these regards is only a beginning, and some conspicuous weak links still exist today (such as biological post-processing techniques); consequently, further attention and work is needed to strengthen the weak links and fill in the voids. The topic that most merits attention right now is basic research on biological engineering. Though we have already done some work on gene expression and control, nucleoplasm correlation, and cell rejection and cell differentiation, overall basic research remains a fairly weak link, and it lags far behind advanced international standards. Basic research is regarded as "distant water that will not put out a nearby fire;" however, water can accumulate to form a river. If one "waits until thirsty to dig a well", that will be too late, and when that time comes, he will have to search far and wide and still not find any. Without sufficient accumulation of data and guidance from basic research, it will be difficult to sustain and deepen applied research and developmental work on biological engineering, and creative pioneering of new applied and developmental research fields will be even more elusive. All people have to do is look at the research on biological engineering being done in China today, most of which imitates work done in foreign countries, and it will not be difficult to understand this reasoning. For research institutions and schools having requisite facilities to plan various important basic research to be done and to fund them accordingly is truly an urgent task of the moment.

In other new leading edge fields of learning, there are also some very important research links that are weak or voids that need filling such as molecular immunology, molecular neurobiology, and developmental neurobiology. Some countries would like to cooperate and make exchanges with China on some of these subjects, and some even want China to help them start research work. We just do not presently have the personnel to do this. We must spot and train some young talent as quickly as possible to build up and develop research work gradually in these fields.

4. Concurrent Concern For Other Fields of Study Simultaneous With Giving Attention to the Development of Leading Edge Fields of Study

Along with the priority development of new leading edge fields of study, the whole picture has to be looked at as well to enable proper development of other fields of biology. The most important part of this problem is the need to increase understanding about the ordinary fields of biology. Many comrades are extremely enthusiastic about developing leading edge fields of learning, and this is very good. However, some comrades pay attention only to the leading edge fields while neglecting or slighting the ordinary fields. They suppose that the regular fields are of little importance or that they do not matter. Such an understanding has a wide influence on young comrades. As a result, in some biological research units, there is more money than can be used for work in the new leading edge fields of learning, while even the most minimal funds are lacking for research in ordinary fields of study. In some institutions of higher learning, there is a lot of enthusiasm for leading edge specialties or departments for which not the slightest foundation exists, while ordinary fields of study, for which a very good or a considerable foundation exists, are simply allowed to live or die.

In the enrollment of undergraduate or graduate students, the halls where examinations are given to take leading edge courses are as crowded as a market place, but the number of those sitting for examinations in ordinary fields are as few as the stars in the morning sky. Consequently, certain ordinary fields have now become "endangered species," and unless more is done to "protect" and "propagate" them, they will be in danger of becoming extinct.

Both the history of biology and practice in China demonstrate that each of the fields of study in biology was born at a certain time and developed at its own pace; nevertheless, all fields have their own importance. Take one of the oldest traditional fields in biology, taxonomy, which today still holds a significance for the national economy and the people's livelihood, or for the development of biology itselfthat should not be underestimated. During China's resist U.S. aggression and aid Korea period, it was the insect taxonomists and the microbiology taxonomists whose vast knowledge and practical research work unmasked America's criminal actions in spreading harmful insects and toxic bacteria in China's northeast, providing irrefutable proof for the condemnation of the aggressor's immoral behavior and winning the support of world opinion. Working together with the country's medical experts, pathologists and ecologists, they made a major contribution to the great struggle against germ warfare. In the development of the country's wild plants for use, knowledge of the taxonomic genetic relationship of plants is also relied upon to locate major plant stock. After it was discovered abroad that reserpine, a medicine for the treatment of high blood pressure, could be found in Rauwolfia serpentina form India, China very quickly set out on a quest, finding a highly effective medicine for the treatment of high blood pressure in Rauwolfia of Chinese origin that is genetically very close to Rauwolfia serpentina. Cortisone, an important medication used in China for the treatment of rheumatoid arthritis and many other illnesses, was also found through the same method. There are innumerable examples of the role of taxonomy research in building the national economy, in health care, in foreign

trade, in national defense, and in public security, only one or two can be outlined here.

It should also be noted that a close relationship of mutual interaction and mutual impetus exists among the various fields. Certainly progress in the new leading edge fields of biology has a widespread and powerful impact on the ordinary fields of biology. However, development of the ordinary fields of biology likewise generates a certain amount of impetus in the leading edge fields of study. In fact, the new leading edge fields of study resulted from the frequent interaction of different fields of study (including the ordinary fields of study). For example, gene engineering in molecular biology is an outgrowth of the interaction among genetics, biochemistry, biophysics, and microbiology. The birth of plant cell engineering also resulted from the longer term mutual impetus and interaction of plant physiology, cytology, morphology, and genetics.

This demonstrates that the ordinary fields of study in biology most certainly are not insignificant or do not matter, but rather are an indispensable component part of biology. Necessary attention and support to ordinary fields of study in biology will enable them to develop properly, and that is beneficial to the better development of both all of biology and the leading edge fields of study.

The highlighting of key areas and comprehensive planning is an important policy of the Party and the state for the development of science and technology. This important policy should be completely understood and earnestly carried out in practice.

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AGRICULTURAL RESEARCH SYSTEM PROBLEMS, PROSPECTS

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[Article by Han Limin [7281 4539 3046], Northwest Agricultural University: "Several Problems in Agricultural Research System Reform That Should Be Given Priority Attention"]

[Text] This article points out that reform of the agricultural research system is a reform carried out at several levels and in several directions. Problems in four areas should be given priority consideration in the process of reform as follows: Readjustment of the overall pattern of agricultural research; improvement of lateral ties in the agricultural science and technology field; increase in the ability of agricultural science units to respond to emergencies; and correct handling of the dialectic relationship between pressures and dynamism and vitality. One urgent need today in order for reform to achieve anticipated results is the formulation of feasible and effective complete reform plans so as to be able to adopt different strategies to deal with different situations.

Reform of the agricultural scientific research system is a fundamental link in reform of the overall agricultural science and technology system. In view of the present state of China's agricultural research system, priority consideration should be given in the course of reform to problems in the four areas discussed below.

1. Readjustment of the Overall Pattern of Agricultural Research

By the overall pattern of agricultural research is meant the regional placement of agricultural research agencies. This placement should follow from the general laws of the pattern of productivity.

The regional placement of agricultural research agencies is affected by the multiple factors of natural conditions, economic conditions, science and technology conditions, and educational conditions. These conditions themselves and their constituent elements will vary greatly. Therefore, scientific research units located in places having different conditions will produce different socio-economic results. In the regional placement of agricultural research agencies, we must act in accordance with natural laws, economic laws, and the laws of science and technology, give overall consideration to the affect of various conditions, and be sure to make lateral

comparisons so as to select the most suitable environment in terms of natural conditions and scientific and technical conditions for the placement of agricultural research agencies. This is the only way to help link scientific research closely to the economy, to help the rational development and use of agricultural resources, to help make the most of regions' natural and economic advantages, and to release fully the science and technology potential of agricultural research units.

Nevertheless, because we have long violated the requirements of objectives laws in the overall placement of agricultural research, the following several erroneous tendencies have occurred:

(1) The location of an overwhelming majority of the country's agricultural research agencies has been decided not on the basis of natural or economic regions, but on the basis of administrative regions. This has resulted both in agricultural research agencies' scientific research priorities for agricultural research being different from the main tasks of the agricultural production centers in the regions where they are located, and in "Jurisdictional interference" from administrative regions in the diffusion of scientific and technical information by the agricultural research agencies.

(2) The location of agricultural research agencies close to administrative organizations has produced a situation in which agricultural research agencies are cut off from each other, while, in other instances, there has been a duplication of agricultural research agencies within the same region.

(3) Because of the lack of a grand design and of overall planning in the placement of agricultural research agencies in China, there has been both duplication in setting up agricultural research agencies in the same region and needless dispersal of locations. Numerous agricultural research agencies specializing in the same kinds of research have appeared at the same time in countless regions with no indication of their relative status, with the result that science and technology manpower, material, and financial resources are spread too thin. This not only does not help raise the level of specialized research in agricultural research but it may lead to the duplication of low level research topics, and a waste of manpower, material, and financial resources.

Therefore, reform of China's agricultural research system has to start with the overall locations of agricultural research, with readjustments being made in accordance with the principle of "rational distribution and proper concentration," and "specialization at high levels and proliferation at low levels."

By "rational distribution" is meant the need to knock down completely the barriers against agricultural research agencies of the "region ownership system," and the "unit ownership system," readjusting the pattern of distribution of agricultural research agencies on the basis of the former natural divisions and economic divisions. "Proper concentration" has a dual meaning. One is the merger of duplicative agricultural research units within

a single administrative region, and the other is a separation into primary and secondary agencies of agricultural agencies in different regions specializing in the same things, giving support to the best one, and merging the lesser with the greater as necessary while maintaining the principle of focusing on key matters. Some agricultural research agencies at lower levels and having lower standards should be made a part of agricultural research agencies at a higher level having higher standards. In this way, manpower, material, and financial resources could be concentrated for a fleshing out and strengthening of agricultural research organizations having higher standards, and the duplication of low level agricultural research and practices that are not likely to produce high level results could be eliminated.

By "specialization at high levels and proliferation at low levels" is meant that central government level and provincial level agricultural research agencies, which have abundant scientific and technical personnel, larger amounts of funds, and better facilities, should devote themselves mostly to basic research and applied research in agricultural science. Meanwhile, prefecture (or city), and county level agricultural research units (including county and township level stations for the promotion of agricultural techniques), which are more limited because of the quality of their personnel, and available funds and equipment, and are thus ill fitted to perform specialized research of great difficulty, should focus their efforts on developmental research for agriculture and promotional services.

Readjustment of the locations of agricultural research is, in a certain sense, the regrouping among regions of productive science and technology elements, and involves "closing down, stopping, merging, and retooling." It is a long-term task that cannot be done in a slapdash fashion. Central government departments concerned will have to conduct in-depth surveys and scientific validations before they formulate a complete readjustment plan, and then put it into effect stage-by-stage, step-by-step, and region-by-region.

2. Strengthening of lateral Agricultural Science and Technology Ties

With acceleration in commercialization of agricultural technology and the opening of rural technology markets, the agricultural research regulatory mechanism is evolving away from an undiversified planning mechanism in the direction of becoming a combination planning and marketing mechanism. Command-style agricultural research plans are being replaced by guidance-style plans, and a public tender system for scientific research, as well as a scientific research contracting system, are spreading everywhere.

The dual regulatory mechanism for agricultural research is manifested primarily in the following ways: (1) Vertical plan regulation. Take the provincial agricultural science academies, for example, which work mostly on research projects proposed by provincial science committees, departments of agriculture and animal husbandry, economic planning committees, and the national Ministry of Agriculture, Animal Husbandry, and Fisheries, and which call for public tenders after which they sign contract agreements with institutes (or laboratories) that have made successful bids and make the research activities of research units a part of state agricultural research

plans. (2) Lateral regulation of technology markets. Agricultural research academies (or institutes) orient themselves actively toward agricultural production, seek their own opportunities and tasks, taking on research tasks on behalf of agricultural enterprises and peasant households. In today's situation of increasing activity in rural technology markets, the active improvement of scientific and technical ties with agricultural research units and production units is extremely important in increasing the income of agricultural research units and in expanding the economics derived from technology of agricultural research units.

Nevertheless, at the present time, agricultural research units everywhere have few laterally obtained scientific research tasks, and a general situation exists of "not having enough to eat." Take the Sichuan Province Academy of Agricultural Sciences' Institute of Soil Fertility as an example. In 1985, this institute made 23 project contracts, allocating 264,000 yuan for research. Only four of these were lateral projects costing 15,000 yuan. Many reasons account for this situation, both internal and external ones. The internal reason is chiefly that reform of the research system is still in the fledgling stage, agricultural research units just now making a transition from doing in-house research only to doing unrestricted research. Their lateral scientific and technical channels are still rather few in number. In addition, the agricultural research system has long been hobbled by "government run research" and "institutionalized research." It finds it difficult to get down off of its high horse of government run research and go into the front lines of production to look for research it can do. The external reason is mostly the fairly low level of development of the rural economy. The peasants have relatively little purchasing power for science and technology, and effective demand for science and technology is still not extremely well developed.

In view of the foregoing situation, agricultural research units must change their longstanding habit of just waiting for work to be assigned, and just riveting their gaze on topics passed down to them from above. Instead, simultaneous with vertical plan regulation, they should become fully engaged in the active opening of channels to production units, strive to expand lateral scientific and technical services, and do all possible in their scientific research activities to account for project expenses, lower expenditures and the cost of technical commodities, winning customer confidence by providing results at a low price and stimulating the demand for science and technology of customers engaged in production.

3. Improvement of Rural Research Units' Ability to Meet Emergencies

The essence of the rural science and technology system is to inject agricultural research agencies into the technology market, a very large portion of research activities thereby becoming directly regulated by the rural technology market, and to bring together those who supply and those who demand the results of science and technology, as well as to bring about a close relationship between research and production.

When research organizations take part in and are regulated by the technology market, it is the needs of producing customers that is the "touchstone" for testing whether the results of technology can be readily marketed. "The customer is always right" becomes the "motto" of agricultural research units engaged in dealing in technology. The trend of demand in technology markets becomes a "guidance device" that regulates the direction of agricultural research. Practice in agricultural production places demands of many different kinds on science and technology, and these demands constantly change with time. This requires that agricultural research units steadily improve their own adaptability and ability to meet emergencies.

The way to improve adaptability and ability to respond to emergencies of agricultural research units is, first of all, the establishment and perfection of a technology market information system that enables scientific research units to keep abreast of technology market developments at all times, to readjust the direction of research, and to make the right research choices. The current situation in China shows that numerous agricultural research units lack a system for collecting, processing, and storing information about production needs, to say nothing of feedback on their research work. Though it is true that numerous research academies (or institutes) have no science and technology information agencies (or offices), it is also true that they pay attention only to tracking action trends and data services, while ignoring the collection of information about the need for technology in the front lines of production. This situation has to be changed as quickly as possible. Second, the ossified structure of agricultural research organizations must be reformed. China's agriculture has entered a period of increasing emphasis on economic results. Today, the peasants particularly welcome results of agricultural science and technology that are "short, level, and speedy" (by which is meant a small amount of investment, quickly visible results, and a short cycle). [This explanation varies from the more usual one, which is a short period between the time technology is developed to the time that it is used in production, a technological level that is suited to medium and small-sized enterprises as well as township and town enterprises, and speedy economic results.] Agricultural science and technology in this category includes the rearing of aquatic products, the raising of domestic livestock, keeping agricultural commodities fresh, storage and processing technology, and technology for growing flowers and plants. However, these are deficiences in China's agricultural research sector. For a long time, China's agricultural research system has suffered from the effects of the erroneous tendency of "taking grain as the key link and complete denudation," restricting the purview of scientific research on agriculture to a narrow sphere of farming, and deploying research forces mostly in the field of grain, cotton, and oil-bearing crops. Statistics from 1982 show that only 103 of the country's 414 institutes at the prefecture (or city) level did research on livestock raising, veterinary medicine, horticulture, aquatic products, and special crops. Of the country's 31,623 agricultural research personnel, only 4,433, or approximately 14 percent of the total number, did research on aquatic products, horticulture, tea, silkworm mulberry, forestry, or new technology, and their regional distribution was extremely uneven.

As a result of 8 years of rural socio-economic reforms, intensive growth in the form of technological innovation and better management has shown constant increase, and extensive growth has likewise broadened rapidly. The broad masses of peasants increasingly tend to need more diversified technology. In order to provide it, the agricultural research sector will have to look squarely at the mission for which it is responsible, gradually improve adaptability to the needs of the rural technology market, and change the existing undiversified research structure. It will have to give attention to better training of incumbent scientific and technical personnel, and to broadening the specialties and the kinds of knowledge possessed by rural science personnel, the majority of personnel engaged in agricultural science work thereby becoming transformed from narrow gauge to multiple gauge all-around talent. It will also have to pay attention to tapping the potential of existing scientific and technical forces, to making changes and reorganizing, to taking aim at needs for development of the rural economy, to setting up numerous types of flexible research organizations, and to cooperation in tackling difficult problems in order to meet the complex and every-changing needs of the rural science and technology market.

4. Correct Handling of the Dialectic Relationship Between Pressures and Dynamism and Vitality

During the current process of reform of the agricultural research system, rural research units are under two kinds of pressure. One is pressure from superior units to which they are responsible, which is mostly in the form of financial pressure. This means that the state is trying to apply an "external squeeze" by shutting off or reducing funds for scientific research in order to force the agricultural research sector to orient itself toward finding topics to work on that have to do with actual agricultural production, and to try actively to make technology into a money making business that promotes closeness between research and production. The second kind of pressure is invisible pressure from the front lines of production that shows up mostly in a trend toward greater and more diversified expectations from science and technology on the part of the peasants. This poses a stern challenge to the insulated and undiversified agricultural research system. In order to meet needs in development of the rural economy, rural research units have to break their insulated and undiversified pattern of doing research.

We must clearly understand that pressures are simply one kind of external force in the reform of rural research units. They are an external condition. "Internal causes are the basis for changes in things; external causes are the conditions for changes in things. External causes operate through internal causes." The financial pressure that is being exerted on the agricultural research sector has as its goal simply to use "pressure" to promote "changes," and to strengthen the internal vitality and dynamism of agricultural research units for actively orienting themselves toward providing service to agricultural production. However, pressure does not equate to dynamism and vitality. For pressures to change into dynamism and vitality, a series of conditions are necessary as, for example, the following:

1. Loose Economic Environment

A loose economic environment is manifested in the following: (1) The agricultural research system is a special type of rural industrial sector for the creation of scientific and technical products. The outcome of its research and development requires not only the expenditure of tremendous intellectual and physical strength, but also requires the investment of copious amounts of financial and material resources. As agricultural research endeavors develop and the extent of their socialization rises, the needs of agricultural research activities for equipment, materials, and information services rise. A shortage of funds and a low level of investment makes it difficult to satisfy the above needs. According to Ministry of Agriculture, Animal Husbandry and Fisheries statistics for more than 400 agricultural research units nationally, the per capita expenditure for research activities in the agricultural research sector in 1982 was approximately 2,000 yuan, just enough to pay the wages of the research personnel. The highest was for the Gansu Provincial Grasslands Ecology Institute in which per capita expenditures for activities was no more than 5,000-odd yuan. The lowest was the Silkworm Mulberry Institute of the Jiangxi Provincial Academy of Agricultural Sciences where the per capita expenditure was only 97 yuan. (2) The operating environment in the agricultural research system must be such as to make science and technology rather attractive, and to produce fairly strong external economic stimulus for agricultural research units. We know that the operating environment for the agricultural research system is rural villages, and that the customers to be served are the countless millions of scattered peasant households. China's rural economy may be characterized basically as having a low income level for peasant households, slight accumulation of funds, and low purchasing power for science and technology. Moreover, because of the peasants' poor understanding of science and technology and their low educational level, their understanding of the results obtainable from agricultural science and technology, and their ability to absorb and digest information is low. Consequently, the present rural socio-economic environment is not such as to produce a powerful economic stimulus to the agricultural research system. All the foregoing means that the economic environment that the agricultural research system faces is a fairly formidable one, and that the economic structures for beginning reform of the agricultural research system are extremely harsh. Under these circumstances, agricultural research units are neither able to rely on the financial resources of the state to amplify the strength that they derive from the economics of technology, nor is it easy for them to go to rural villages to put technology on a businesslike basis in rural villages to earn money; thus reform has a difficult road to travel. If higher authority exerts too much pressures on expenses, the extent of research system reform will be further curtailed. Then, pressures will not only not bring about dynamism and vitality, but rather they will saddle the agricultural research system with a heavy economic burden that further binds reforms hand and foot, leading to a shriveling of agricultural research endeavors that will affect the stability of the agricultural foundation.

2. Strengthening the Internal Mechanism

The organizational structure of the agricultural research system (including the agricultural research management coordination structure, the administrative

structure, the information facilities service structure, the scientific and technical personnel quality structure, and the scientific research work organizational structure, etc.), is the "blood making mechanism" of the agricultural research system, and it is also the factor for increasing the vitality of the agricultural research system. One can imagine that without an agricultural research management and administration corps with experience in administration and effectiveness in management, the operating efficiency of the agricultural research system is bound to decline, and it will also be difficult for it to have any inherent vitality. If a technology markets information service system is lacking, information about the scientific and technical needs of the front lines of agricultural production can hardly be fed back to agricultural research units. If agricultural research units find it hard to receive stimulus from the needs of the outside world, they will remain in a sealed off research enclosure, making it difficult for them to produce the dynamism necessary to orient their activities toward agriculture and to serve agricultural production.

To summarize, reform of the agricultural research system is a multi-level, multi-directional, combined internal and external system reform. Good performance in this reform requires the formulation of feasible and effective complete complete reform plans, as well as focusing on the adoption of different reform strategies for different situations. Otherwise, if strengthening the agricultural research system's internal mechanism is neglected and sole reliance is placed on a reform strategy of "external pressure," and undiversified regulatory methods, reforms can hardly produce the desired results.

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Beefed Up Command, Control System for Strategic Missile Forces

40080133a Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 5 May 88 p 4

[Text] Beijing, 4 May (XINHUA)--For more than a decade, China has been developing an automated command and control network for coordinating China's strategic missile forces. By mid-April of this year, the basic structure and the technical components of this network have been completed, and the entire network is expected to be operational soon.

According to the PEOPLE'S LIBERATION ARMY'S NEWS, as part of the effort to develop this network, China's military research offices had generated more than 500 new products; nearly 100 of these had received the national award for technology advancement and the military scientific achievement award. These achievements signified a new phase in the modernization of China's strategic missile forces.

In 1973, a research office was established by China's 2nd Artillery Forces to develop an automated artillery command and control system. This office made a significant contribution not only to military automation but also to China's computer industry by development China's first Chinese-character computer terminal.

In an effort to develop the automated command and control system, the research office carried out a two-phase study on five different subsystems. Within each subsystem, it had developed many technical products which were considered to be state-of-the-art accomplishments by world standards.

For example, in the area of secure communications, the accomplishments included the "video graphics and character processing system," the "color graphics and Chinese-character display system," and the "study of performance measure for data communication system." By applying these advanced technologies, one can establish effective communication links between the front-line missile forces and the different levels of command units. They can exchange battle information and documents via display terminals of the automated system. The old techniques of using telephones and teletypes for battle command and control are now obsolete; we have entered a new era of automation.

In the area of monitoring missile flight conditions, the accomplishments included the "ballistic telemetry system," the "infrared detection system" and the "visible-light detection system." By using a command and control system with audio, video, and data transmission capabilities, the commander can effectively control the battle forces. These research accomplishments contributed to the success of the overall development of the automated command and control systems.

3012/12232

Modern Control Center for Nation's Space Effort

40080133b Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 30 May 88 p 4

[Text] Twenty years ago, when a missile test was being conducted in northwestern China, Premier Zhou Enlai tried to find out the test results by telephone; but due to the poor command and control facilities available at that time, he failed to obtain a definitive answer even though repeated phone calls were made. Today, the situation has changed. Whether it is a missile test in the Gobi Desert, or a satellite launch from the Space City in the Southwest, whether is it a missile splash-down in the Pacific Ocean, or a satellite orbiting at 36,000 km above the earth, Beijing would have a clear view of all the activities.

During the certification conference held in Beijing on 28 May, it was demonstrated that the Command and Control Center developed by the Commission of Science, Technology and Industry for National Defense is capable of high-speed, accurate and multi-directional reception and transmission of information. Experts agree that after nearly 10 years of development, this Center has become a large, full-capability modern command and control facility which can satisfy the current needs of various research and test activities for national defense. In 1978, the Commission of Science, Technology and Industry for National Defense established a program office for directing the effort of developing a Control Center for defense research and test in Beijing. On 18 May 1980, Deng Xiaoping and other high officials watched from this office the testing of China's space launch vehicle launched toward the Pacific Ocean. Since that time, improvements have been made to the Center by applying systems engineering principles. Specifically, the technical staff of the Center spent 7 years developing an automated control system which can serve the functions of launching strategic weapons as well as testing space vehicles. As part of the development effort, more than 100 scientific breakthroughs have been achieved during the past 10 years. Records show that the Control Center has successfully conducted 38 major tests including long-range space launch vehicles, cruise missiles, retrievable satellites and communications satellites.

3012/12232

MECHANICAL PROBLEMS IN HIGH-TEMPERATURE GAS-COOLED REACTOR STRUCTURES

40090108a Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 9 No 2, Apr 88 pp 23-27, 73

[English abstract of article by Dong Duo [5516 6995], et al.]

[Text] This article mainly introduces mechanical problems in HTGR [high-temperature gas-cooled reactor] structures. Since graphite is adopted as the major structural material, the study of the mechanical behavior of graphite under high temperature, high radiation and oxidization becomes the main point in this paper. The physical and mechanical properties of graphite, the fatigue behavior of graphite and the stress clarification and failure criteria under the conditions in question are discussed. The paper also introduces the creeping and cracking problems of concrete in the stress analysis of HTGR pressure vessels (PCPV).

9717

CONTROLLING pH OF PRIMARY CIRCUIT COOLANT OF PWR BY ION EXCHANGE RESIN

40090108b Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 9 No 2, Apr 88 pp 66-73

[English abstract of article by Zhou Daorong [0719 6670 1369], et al.]

[Text] This paper describes maintaining the pH and performance while removing impurities, using the mixed-bed in the Li^+- and OH^+-form resin, in the PWR's primary circuit coolant. The mixed-bed parameter and its effect factor and systematic technology conditions for maintaining the pH in loop water are given.

All the results of a laboratory test and a long-term operating test in the corrosion loop of an element with heat flux have been confirmed.

9717

STUDY OF TECHNETIUM CHEMISTRY. I. GENERAL RULE OF STABILITY FOR STRUCTURES OF TECHNETIUM COMPOUNDS

40090105a Beijing HE HUAXUE YU FANGSHE HUAXUE [JOURNAL OF NUCLEAR AND RADIO-CHEMISTRY] in Chinese Vol 10 No 2, May 88 pp 65-77

[English abstract of article by Wei Yi [7614 3015], et al., of the Radio and Radiation Chemistry Division, Beijing Normal University]

[Text] Having studied the structures of more than 100 technetium compounds, the authors propose a packing saturation principle based on the cone packing model and the normalized "Van der Waals" radii in which the sum of the solid angle factors (SAF) of all coordinating ligands reaches a stable region, with an average value of 0.97 and a characteristic error of ± 0.13 (no more than the SAF of one common ligand). It is found that the steric effect due to geometric factors is quite important and deserves more attention in designing technetium compounds with predicted structures.

9717

α-HYDROXY-α-METHYLBUTYRIC ACID--A BETTER ELUANT THAN α-HYDROXYISOBUTYRIC ACID FOR CATION EXCHANGE CHROMATOGRAPHIC SEPARATION OF Am(III), Cm(III)

40090105b Beijing HE HUAXUE YU FANGSHE HUAXUE [JOURNAL OF NUCLEAR AND RADIOCHEMISTRY] in Chinese Vol 10 No 2, May 88 pp 78-83

[English abstract of article by Chen Zhongdui [7115 1813 1417], et al., of Northwest Institute of Nuclear Technology]

[Text] The capabilities of α-hydroxy-α-methylbutyric acid (HMBA) and α-hydroxyisobutyric acid (HIBA) for cation exchange chromatographic separation of Am(III)-Cm(III) under the same conditions have been studied. The separation factor of these two elements obtained using HIBA as the eluant is 1.37, which agrees with the data given in the literature, while that obtained using HMBA as the eluant is 1.71. It can easily be seen from these data that HMBA is a better eluting agent for the cation exchange chromatographic separation of Am(III)-Cm(III) than HIBA.

Many factors which could affect the effectiveness of Am(III)-Cm(III) separation using HMBA as the eluant have also been studied before employing HMBA as a practical eluting agent, and it has been found that quite satisfactory results in the cation exchange chromatographic separation of Am(III)-Cm(III) can be obtained when using an eluting solution containing 0.3 to 0.4 mol/l of HMBA in the pH range from 4.0 to 4.4 and in the temperature range from 25 to 70°C.

9717

ISOTOPIC EFFECT OF U(III)-U(IV) ISOTOPIC EXCHANGE PROCESS

40090105c Beijing HE HUAXUE YU FANGSHE HUAXUE [JOURNAL OF NUCLEAR AND RADIO-CHEMISTRY] in Chinese Vol 10 No 2, May 88 pp 95-100

[English abstract of article by Yang Enbo [2799 1869 3134], et al., of the Institute of Atomic Energy, Beijing]

[Text] The U(III)-U(IV) isotopic exchange process in 7.0 mol/l HCl aqueous solution and in U(III)-7.0 mol/l HCl-U(IV)-50 percent TBP-kerosens and U(III)-7.0 mol/l HCl-U(IV)-50 percent TBP-xylene systems is found to give single stage separation factors of 1.0026, 1.0031 and 1.0030 respectively. These results agree quite well with Delvalle's experimental values (1.0025 - 1.0030). Based on this study, the exchange systems using TBP-xylene and DiABP-xylene as extractants have been selected for further study of ^{235}U enrichment.

9717

EFFECT OF MOLYBDENUM ON SOLVENT EXTRACTION OF NIOBIUM FROM NITRIC ACID

40090105d Beijing HE HUAXUE YU FANGSHE HUAXUE [JOURNAL OF NUCLEAR AND RADIOCHEMISTRY] in Chinese Vol 10 No 2, May 88 pp 101-106

[English abstract of article by Lin Cansheng [2651 3503 3932], et al., of the Institute of Atomic Energy, Beijing]

[Text] This paper shows the effect of macro amounts of molybdenum on the extraction of micro amounts of niobium, using different solvents, from an aqueous phase containing nitric acid, nitrate and molybdenum at various concentrations. Niobium-95 and molybdenum-99 tracers are used to determine the distribution coefficients of niobium and molybdenum. The results indicate that molybdenum exerts an obvious effect on the extraction of niobium from 0.4 - 1.0 mol/l HNO_3 by TBP, HDBP and Aliquat-7402. The distribution coefficient of niobium increases by 4 to 254 times with the addition of inactive molybdenum into the extraction system.

Based on the experimental data, equations are suggested for the extraction equilibrium of niobium and molybdenum. The results of slope analysis show that the extracted niobium species by HDBP is a mixture in the following form: $2[Nb(OH)(NO_3)_3][H_2(DBP)_3] + [Nb(OH)(NO_3)_2][H_2(DBP)_4]$.

9717

Revision To Parallel Algorithm for Supercomputers Proposed

40080135a Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese
Vol 11 No 2, Feb 88 pp 127-128

[Article by Zhang Lijun [1728 7787 0689], Fudan University: "A Remark on 'The Supercomputer YH-1 [Galaxy 1] and Parallel Algorithms'"; manuscript received 13 April 1987]

[Text] Editor's note: After we published the article "The Supercomputer YH-1 and Parallel Algorithms" in our second issue of 1987, reader Comrade Zhang Lijun proposed a partial revision (see text). To invigorate the scholastic spirit, we include an abstract of a letter from Comrade Ci Yungui [1964 0061 2710] in the correspondence column of this issue, together with the Zhang article. [End of note]

In the third part of [1], example 4 of "timing differences between serial algorithms and parallel algorithms," which is used by the author to explain the differences in time complexity between serial algorithms and parallel algorithms, should be supplemented with the following:

Example 4 introduces a parallel algorithm using division operations to calculate x^n. The time for parallel calculation of this algorithm is

$$T_n = \lceil \log n \rceil \tau_+ + 2(\tau_+ + \tau_+) \qquad (1)$$

It is also said in [1] that for parallel processors, raising x to the power of n requires $T_1 = (n-1)\tau_*$ (where log n is always base 2).

Actually, the time for parallel computation of x^n is much less than $(n-1)\tau_*$. For example, calculating x^n requires only the following calculations:

$$x^2, x^4, x^8, x^{16}, x^{17}$$

Five multiplications in all, rather than 16 multiplications. Generally speaking, Knuth [2] has pointed out that for a parallel algorithm calculating x^n, the time complexity is

$$T_1 = \lfloor \log n + O(\log n / \log \log n) \rfloor \tau_*$$

Consequently, Borodin and Munro[3] have proven the following conclusion for parallel algorithms:

If division is not used, no matter how many processors are used, the lower bound for parallel calculations of x^n is $\lceil \log n \rceil \tau_*$. Obviously, the complexity for both the parallel calculations and a calculation without division is the same, and there is fundamentally no real improvement. Therefore, in 1976 Kung[4] proposed the use of a parallel algorithm using division calculations in the example 4 stated above. Moreover, Kung explains in [4] that because

$$\lim_{n\to\infty} \lceil \log n \rceil \tau_* / [\lceil \log n \rceil \tau_+ + 2(\tau_+ + \tau_\div)] = \tau_* / \tau_+$$

this is a faster algorithm for parallel computers where the calculation times of similar multiplications are longer than for addition calculations.

According to an explanation in the user's manual of the YH-1 Supercomputer, the times for multiplication algorithms and for addition algorithms on the YH-1 computer are the same. This algorithm is not suitable for the YH computer.

It would appear to be more useful for this example to be used to explain that when the same parallel algorithm is run on different parallel computers, different results might be obtained.

References

[1] Ci Yungui and Li Xiaomei [2621 2556 2734]. "The Supercomputer YH-1 and Parallel Algorithms." JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] 10:2 (1987), 121-128.

[2] D.E. Knuth. The Art of Computer Programming. Vol 2: Seminumerical Algorithms. Reading, Mass.: Addison-Wesley, 1969.

[3] A.B. Borodin and I. Munro. Notes on Efficient and Optimal Algorithms. Toronto and Waterloo: U. of Toronto and U. of Waterloo, 1972.

[4] H.T. Kung. "New Algorithms and Lower Bounds for the Parallel Evaluation of Certain Rational Expressions and Recurrences." Journal of the Association for Computing Machinery 23:2 (1976): 252-261.

Original author's responses: Comrade Ci Yungui has written to say, "Comrade Zhang Lijun is correct in saying that the time complexity for the serial algorithms for example 4 in the third part of my paper is

$$T_1 = [\log n + O(\log n / \log \log n)]\tau_*,$$

rather than my $(n-1)\tau_*$."

12586/08309

Using N1/2 Method To Select Optimum Parallel Algorithms

40080135b Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese
Vol 11 No 5, May 88 pp 270-277

[Article by Qiao Xiangzhen [0829 7449 3791]: "The Selection of a Good Parallel Algorithm and the n1/2 Method"; manuscript received 9 August 1986]

[Text] Abstract: This paper combines structural characteristics of the 757 vector computer[1] and the Convex C-1 mini-supercomputer[2] with some actual calculations to explain how to use a half performance length n1/2[3] to do performance analyses of algorithms, as well as how to select optimum parallel algorithms for resolving any given problem sensitive to the parallel computer system based on the n1/2 method.

I. Introduction

To meet the demands of large-scale scientific computational problems, people have proposed various kinds of parallel computer systems[4]. With the development of parallel computers has appeared a new category of numerical algorithm: traditional serial algorithms suited to serial computers and now parallel algorithms for use in parallel computers. Since parallel computers have begun to be used, parallel algorithms have continued to be a lively field of research in computer science, and parallel algorithms are also the key to improving usage efficiency for parallel computers. At present, research into parallel algorithms is oriented toward SIMD (single instruction, multiple data) systems. General SIMD systems include two types, one having an array processor (as with the ICL DAP and the ILLIAC IV[3]) and the other a vector processor. From the viewpoint of memory access, the vector computers are further divided into vector machines with vertical processing mode but without vector registers (as for example the CDC Star 100 and the CDC Cyber 205), and the horizontal and vertical processing vector computers with vector registers (as for example the Cray-1[3], the Convex C-1[2], and China's YH-1 [Galaxyl] and the 757). Changes in system structure have allowed parallel algorithm design to exhibit some characteristics that are different from serial algorithms. The appearance of parallel computers has greatly changed the performance ratio of the best and worst computer routines for solving a particular problem (here, the performance of an algorithm or computer program is defined as the inverse ratio of the time for execution of an algorithm or routine). On serial computers, this ratio is generally 2-3 times,

while on parallel computers this ratio can be 10 times or more. Consequently, research on parallel algorithms has attracted much attention. On serial computers, there is usually only one consideration for selecting the optimum algorithm for a particular problem, that is, the one chosen has the least number of calculation operations (sometimes, the least amount of storage is also considered). But on parallel computers the goal of the least amount of time in execution is not necessarily the same as having the minimum number of calculation operations to be executed. This is because of the gain obtained from enhancing the parallel nature of an algorithm, which exceeds the overhead introduced by increasing the number of calculations. Consequently, it is not necessarily true that an efficient serial algorithm will result in an efficient parallel algorithm. To select an optimum algorithm for a particular parallel computer, many factors should be considered. In [3], R.W. Hockney proposed the concept of the half-performance length nl/2 and the approximation performance (maximum performance) r_∞ , and the algorithm analysis nl/2 method he proposed is a natural extension of selecting the optimum serial algorithm according to the quantity of operations. It is a feasible tool for choosing efficient parallel algorithms on a parallel computer and has consequently been gaining respect by others. This paper combines the structural characteristics of the 757 and Convex C-1 vector computers to analyze how to use the nl/2 method to choose high efficiency parallel algorithms suitable for use on vector computers, as well as for problems that must be considered in the design of parallel algorithm design.

As a convenience for the following discussion, we include here the following definitions:

1. The degree of algorithm parallelism: for any step of an algorithm, the definition of the degree of algorithm parallelism is the number of the algorithm operations that are mutually independent and can be executed in parallel.

2. The natural degree of parallelism in hardware: this refers to the number of elements (or vector lengths) when the hardware is running parallel operations on a group of elements (or a vector) and reaches optimum performance. The natural degree of parallelism for an array processor is the number of parallel processors; the hardware natural degree of parallelism for vertical and horizontal processing vector machines is the length of the vector register. For example, that of the 757 is 16, of the YH-1 is 128, and for the Convex C-1 it is 128.

3. The parallel acceleration ratio: for any given problem (A), let Tp be the execution time for the parallel algorithm used in a parallel computer system to solve (A), and let T_1 be the execution time for the optimum serial algorithm known to correspond, then the "acceleration ratio" of the parallel algorithm to the serial algorithm is defined as $S_p = T_1/T_p$.

II. The nl/2 Method of Algorithm Analysis

The appearance of a new generation of parallel computers has brought a series of new topics for numerical analysis, among which one important problem is how to choose the optimum algorithm to solve a particular problem ('optimum' here means

the shortest execution time). R.W. Hockney[3] explored the use of computer time parameters to analyze this problem. The simplest reasonable hypothesis established by him was to consider an algorithm to be composed of a series of vector instructions, while the linearity of the execution time for one vector instruction depends upon the vector length. To further time analyses in accordance with this hypothesis, Hockney proposed using r_∞ and n1/2 as the two time parameters for the computer. Here, r_∞ is the maximum or approximation performance of the computer, and this value generally appears when the vector is infinitely long. The value is usually MFLOPS (resulting value of floating point operations completed each second). n1/2 is the half-performance length, that is, the vector length when a parallel computer attains one-half of maximum value. According to the hypothesis of Hockney, the operation time t of the vector of length n approximately satisfies the following equation:

$$t = r_\infty^{-1}(n + n_{\frac{1}{2}}) \qquad (1)$$

The parameters r_∞ and n1/2 describe the hardware performance of the ideal computer system, and this also provides a preliminary description for any real computer system. Generally speaking, the optimum performance (r_∞) is fundamentally a characteristic parameter of the technology employed by a computer (as for example for clock cycles), while the half-performance length n1/2 is a measure of the degree of parallelism in computer hardware. Equation (1) reflects the size of the overhead incurred by increased parallelism. For serial computer systems, n1/2=0 (they have no parallelism), while for a model of the ideal parallel computer having an infinite number of processors, n1/2 equals infinity. n1/2 for all parallel computer systems is at intervals $(0,\infty)$, and the greater n1/2, the higher the degree of parallelism for the system. The values of (n1/2, r_∞) for a parallel computer may be derived through empirical testing, and may also be deduced from the performance parameters supplied by the maker of the computer[3]. Table 1 provides values of (n1/2, r_∞) for some parallel computer systems. Because a specific computer system can only be used effectively when the vector length for which it is solving is greater than n1/2, the greater n1/2, the greater the extents of problems that can be effectively solved. That is, as the usability of parallel computers declines, so does n1/2 become a measure of the suitability of parallel computer systems.

Table 1. Characteristic Parameters for Some Parallel Computers

Computer Model	n1/2	r_∞(MFLOPS)	$R_\infty = r_{\infty v}/r_{\infty s}$
64-bit Cray-1	10∿20	80	13
48-bit BSP	25∿50	50	20
2-pipe 64-bit Cyber 205	100	100	10
1-pipe 64-bit TIASC	30	12	4
64-bit CDC Star 100	150	25	12
32-bit (64X64) ICLDAP	2,048	16	400
64-bit 757	4∿10	4∿6	4
32-bit Convex C-1	10∿20	40	--

As a preliminary approximation, a parallel algorithm on a parallel computer may be considered as a series of vector operations, where each operation satisfies (1), and therefore the total calculation time T is:

$$T = \sum_{i=1}^{q} r_{\infty}^{-1}(n_i + n_{\frac{1}{2}}) \tag{2}$$

where q is the number of vector operations making up the algorithms and n_i is the number of scalar operations corresponding to the i-th vector operation. If r_{∞} and nl/2 have equivalent approximations for all operations or have suitable average values, it may be presumed that:

$$T = r_{\infty}^{-1}(s + n_{\frac{1}{2}}q) \tag{3}$$

where $s = \sum_{i=1}^{q} n_i$ is the total number of calculations in an algorithm. Going on from (3), we can then compare by using the same parallel computer to resolve the quality of the two parallel algorithms. Given two algorithms a and b that solve a particular problem and calculation times for each of $T^{(a)}$ and $T^{(b)}$, then $T^{(a)}/T^{(b)} = (s^{(a)} + n_{\frac{1}{2}}q^{(a)})/(s^{(b)} + n_{\frac{1}{2}}q^{(b)})$, where r_{∞} cancels out and does not figure in the comparison of the performance of two algorithms. For a given parallel computer system (where nl/2 is known), there are two elements here that function in the selection of the optimum algorithm: s and q, that is, choosing the optimum parallel algorithm is determined by two factors. One is the number of calculation operations in the algorithm, and the other is the degree of parallelism of the algorithm, and both must be considered together. Empirically speaking, if nl/2 is greater (an array or multiple computer system with a high degree of parallelism), then the S component will count less, and improving the degree of parallelism in the algorithm (by reducing q) is the chief paradox; if nl/2 is smaller, then relatively speaking, the function of S is greater. Sometimes the gain from changes in parallelism cannot necessarily make up for the overhead incurred by increases in the number of calculations, and at this time one should select the "compatible" parallel algorithm (there is no strict definition of 'compatible', but roughly speaking, it means that the number of calculations in a parallel algorithm is at the same order as the number of calculations for the corresponding serial algorithm).

The 757 and Convex C-1 vector computers are among the vertical and horizontal processing vector computer systems. The value of nl/2 is smaller, the degree of parallelism is low, and they are very flexible. There are two principles for choosing the optimum parallel algorithm to solve a particular problem: one is to select a parallel algorithm in which the number of calculation operations is "compatible" with the optimum serial algorithm, and a second is to allow the degree of parallelism of the algorithm to match the degree of parallelism in the computer, that is, as much as possible in vector operations to use multiples in lengths of 16 (for the 757 vector computer) or 128 (for the Convex C-1).

III. Some Examples of Algorithms

3.1 Matrix multiplication

From the point of view of mathematics, the product C (elements of which are $C_{i,j}$) of two matrices A and B of order N (elements of which are $A_{i,j}$ and $B_{i,j}$) satisfies the following equation:

$$C_{i,j} = \sum_{k=1}^{N} A_{i,k} * B_{k,j} \quad 1 \leqslant i,j \leqslant N \tag{4}$$

On a regular serial computer, (4) is calculated using inner products. In FORTRAN, this may be expressed as:

```
      DO 20 I=1,N
      DO 20 J=1,N
       C[I,J]=0.0
      DO 20 K=1,N
20     C[I,J]=C[I,J]+A[I,K]*B[K,J]
```

As far as the 757 is concerned, this algorithm can be directly vectorized ("inner products method") and can be cyclically vectorized at the J and I levels ("outer products method"). The computing times for these two methods are $T_I = r_\infty^{-1} * (S_I + n_{\frac{1}{2}} \cdot q_I)$ and $T_O = r_\infty^{-1} \times (S_O + n_{\frac{1}{2}} \cdot q_O)$, respectively, so obviously $S_O = S_I$, but on the 757 vector computer $q_I > q_O$, and so the "outer products method" is better than the "inner products method." For an example where N=500, on the Convex C-1 vector computer, the speed of calculation for the "outer products method" was 1.56 times faster than that of the "inner products method." This simple calculation example shows that in similar algorithms, instead of the "inner products methods" one can invariably substitute algorithms that do not increase the number of calculations and that have even higher degrees of parallelism, as for example with the multiplication of matrices and vectors, the solving of the back substitution process for groups of linear algebra equations, and convolution calculations in petroleum and seismic data processing.

3.2 Fast Fourier Transform algorithms

For a given repeating sequence x sub k containing N number of elements, where k=0,1,...,n-1, the discrete Fourier transform is another repeating sequence $y_j (0 \leqslant j \leqslant N-1)$, containing N elements, which satisfies:

$$y_j = \sum_{k=0}^{N-1} x_k \cdot e^{-(2\pi jk/N)i} \quad (0 \leqslant j \leqslant N-1) \tag{5}$$

where $i = \sqrt{-1}$.

To simplify matters, if $N = 2^m$, where m is a positive integer, then $W_N = e^{-(2\pi/N)i}$ is an N root of unity. Using the Cooley-Tukey Fast Fourier Transform (FFT)[5], the calculations just described will require only $\frac{N}{2} \cdot m$ multiple multiplication and $N \cdot m$ multiple addition operations. It is generally considered that FFT computation is naturally parallel, but when running on a vector computer, as the vector length gets shorter and shorter, the number of vector operations is increased, namely, the value q in the time equation (3). To improve the efficiency of the FFT parallel calculations, one should use vector calculations of length N/2 to as great a degree as possible. One possible method on the 757 or the Convex C-1 vector computers is that after each step of the iterative calculations the data be rearranged maintaining the interval between even points at N/2 (the same as in the first example), which will allow for iteration throughout the entire array, maintaining a vector calculation length of N/2. The following function can be realized from the permutation matrix PS (Perfect Shuffle[6]) in the following equation definition:

$$PS \cdot (x_0, x_{N/2}, x_1, x_{N/2+1}, \cdots, x_{N-1}) = (x_0, x_1, \cdots, x_{N-1})$$

Therefore, parallel FFT algorithms that may be supplied for the 757 and Convex C-1 vector computers are composed of the following three parts: 1) vectors $(x_{N/2}, x_{N/2+1}, \cdots, x_{N-1})$ of length N/2 multiplied by the appropriate factor W^p; 2) calculations of the sum and difference of two vectors of length N/2; 3) data rearrangement, that is, two vectors of length N/2 are stored as vectors according to intervals (the results are the same as the function of the permutation matrix PS on the vector $(x_0, x_{N/2}, x_1, x_{N/2+1}, \cdots, x_{N-1})$. The natural vectorization of a serial algorithm and the time analysis for the parallel algorithm described here (the vector length is kept at a constant) are each as follows:

$$T_1 = r_\infty^{-1}(S_1 + n_{\frac{1}{2}} q_1)$$
$$T_2 = r_\infty^{-1}(S_2 + n_{\frac{1}{2}} q_2)$$

Obviously, $S_1 = S_2$, and for the 757 vector computer $q_2 = \frac{N}{32} * m * q_e$,

$q_1 = \left(\frac{N}{32} * (m-4) + \frac{N}{16} + \frac{N}{8} + \frac{N}{4} + \frac{N}{2}\right) * q_e$, where qe is the number of vector operations to calculate one point which is generally one repeated multiplication and two repeated additions, $q_1 > q_2$, and consequently for the 757 vector computer the latter method is more effective. The calculation speed to actually calculate and test an FFT can be as fast as 4 mFLOPS. On the C-1 vector computer, an actual calculation was done using the two methods and also the traditional scalar method. The test results show the parallel speed increase ratio of the natural vectorization method to be $S_p \doteq 2$, and the parallel increase ratio of the second method (equal length vectors) to be approximately 6 (see Table 2).

Table 2. Calculation Results From the Convex C-1

Problem	Algorithm	Calculation time (s)	Speed Increase Ratio
Matrix mult.	serial	387.3193	1
(N=500)	inner prod.	38.9827	9.9
	outer prod.	25.0189	15.5
FFT	serial	0.3492	1
(N=4,096)	natural parallel	1.1573	2.2
	equal length vectorization	0.5861*10 super -1	6.0
non-linear equation	binary method	0.2369*10 super -2	1
root extraction	mult. components	0.5106*10 super -2	0.46
recursion	serial	0.1579*10 super -1	1
(N=4,096)	multiplier	0.1684*10 super -1	0.94
	cycle doubling	0.9144*10 super -1	1.73

3.3 Parallel Calculations of Recursion

The recursion problem:

$$\begin{cases} x_1 = b_1 \\ x_i = a_i x_{i-1} + b_i \quad 2 \leqslant i \leqslant N \end{cases} \tag{6}$$

This is a very effective calculation technique among serial algorithms that saves on the number of calculations, and the calculation results at each step will be used in the next iteration, so it appears to be very difficult to calculate all values of x_i at the same time, but by modifying the equation just described just a little we can obtain various parallel algorithms with speed increase ratios of $N/\log_2 N$[7]. For the following, if $N = 2^m, m$, m is a positive integer.

1. The multiplier method.

The multiplier method is an often seen parallel resolution method for recursion problems, the calculation formula for which is as shown below.

For $l = 1, 2, \cdots, \log_2 N$ calculate:

$$x_j = a_j^{(l)} x_{j-2^l} + b_j^{(l)} \qquad (2^l + 1 \leqslant j \leqslant N)$$

where:

$$a_j^{(l)} = a_j^{(l-1)} \cdot a_{j-2^{l-1}}^{(l-1)} \qquad (2^l + 1 \leqslant j \leqslant N) \tag{7}$$

$$b_j^{(l)} = a_j^{(l-1)} \cdot b_{j-2^{l-1}}^{(l-1)} + b_j^{(l-1)} \tag{8}$$

The initial value is: $a_j^{(0)} = a_j$, $b_j^{(0)} = b_j$.

That is, the calculation of $x_j(2 \leqslant j \leqslant N)$ is accomplished in $\log_2 N$ steps, where the 1-th step $(1 \leqslant l \leqslant m)$ computes to j having the 2^{l-1} value $j \in [2^{l-1}+1, 2^l]$ and $x_j = b_j^{[\log_2 j]}$. Equations (7) and (8) may be calculated in parallel. The total number of calculation operations is $2N \cdot (\log_2 N - 1)$ multiplications and $(N \log_2 N - 1)$ additions. And the number of calculation operations for the serial algorithm (6) is (N-1) multiplication and addition calculations, and the numbers of calculation operations for both are of different orders.

2. The cycle doubling method.

The cycle doubling method is another often seen parallel recursion algorithm, the calculation process for which is as follows.

To calculate $j = 0, 1, 2, \cdots, (m-1)$

$$x_{1+i \cdot 2^j} = a_{1+i \cdot 2^j}^{(j)} \cdot x_{1+(i-1) \cdot 2^j} + b_{1+i \cdot 2^j}^{(j)} \tag{9}$$

where:

$$\begin{aligned} &i = 1, 3, 5, \cdots, 2^{m-j} - 1, \\ &a_{1+i \cdot 2^j}^{(j)} = a_{1+i \cdot 2^j}^{(j-1)} \cdot a_{1+(i-\frac{1}{2}) \cdot 2^j}^{(j-1)} \\ &b_{1+i \cdot 2^j}^{(j)} = a_{1+i \cdot 2^j}^{(j-1)} \cdot b_{1+(i-\frac{1}{2}) \cdot 2^j}^{(j-1)} + b_{1+i \cdot 2^j}^{(j-1)} \\ &(j = 1, 2, \cdots, m-1) \end{aligned} \tag{10}$$

The initial values are:

$$\begin{aligned} a_k^{(0)} &= a_k \qquad (2 \leqslant k \leqslant N) \\ b_k^{(0)} &= b_k \qquad (1 \leqslant k \leqslant N) \end{aligned}$$

The calculations are accomplished in two steps, the first calculating $a_{1+i \cdot 2^j}^{(j)}$, $b_{1+i \cdot 2^j}^{(j)}$, according to (10), requiring the calculation of $\log_2 N - 1$ steps $(1 \leqslant j \leqslant m-1)$ the length of the j-th step will finish up as one vector multiplication and two vector addition calculations of $2^{m-j} - 1$. Only then use (9) to obtain $x_{1+i \cdot 2^j} (j = m-1, \cdots, 2, 1, 0)$, a total number of steps at $\log_2 N$, where each step achieves a length of vector multiplication and addition calculations at 2^{m-j-1}, the total number of operations being: 3N multiplications and 2N additions. Therefore, this is a parallel method "compatible" with the serial algorithm, and when N is greater, the parallel efficiency will be greater than the multiplier method.

We ran comparisons on the Convex C-1 vector computer for the serial algorithm and multiplier parallel method, and for the cycle doubling parallel method, the actual computational results of which showed that the cycle doubling parallel method was superior to the traditional serial method, while the multiplier parallel method was inferior to the serial method. This calculation example shows the importance of selecting a "compatible" parallel algorithm (see Table 2 for the calculation example).

3.4 Non-linear equation root extraction.

For general parallel computer systems, equipped with n1/2 is greater than 0 array or pipeline processor components, the maximum processing speed is outside $r_{\infty v}$, and for those having n1/2 equals 0 scalar processing units, the maximum processing speed is $r_{\infty s}$. On the one hand, when the vector length of the parallel computations is too short, the scalar calculations can be more efficient; on the other hand, when the number of calculations in a parallel algorithm is not compatible with that of the corresponding optimum serial algorithm, it is possible that there is a serial algorithm that is superior to the parallel algorithm (at which time the gain from making the algorithm parallel cannot make up for the overhead incurred by adding to the number of calculations, especially for systems where n1/2 is smaller). Under these two conditions, it is appropriate to use the optimum serial algorithm. To test consideration of the problem of seeking roots from non-linear equations, that is, to solve the equation: $f(x) = 0 \quad x \in [a, b]$ without losing generality, we may presume a=0 and b=1. As far as serial calculations are concerned, the secant line method and the Newton tangent method are both more efficient than the binary method. Regarding the parallel computations, people invariably use the n-ary method in place of the binary method[7] Practice has shown that the n-ary method is not always better than the binary method for all parallel computer systems, for sometimes the secant method or the Newton tangent method is a better choice.

Given a margin of error of $\varepsilon = 2^{-m}$ and the functional values f(0) and f(1), using the binary method to solve the equation just given would require at least m steps of iteration, where each step of iteration calculates the value of f(x) once, and the total number of calculation operations is N_f. When using the n-ary method $(n = 2^k)$ to solve that equation, at least m/k steps of iteration are required, where the number of calculations for each step of iteration is $n \cdot N_f$. Therefore, the times of calculation T_s, T_v for the serial binary method and the parallel n-ary method, respectively, are:

$$T_s \doteq r_{\infty s}^{-1} * S_1, \quad T_v \doteq r_{\infty v}^{-1}(s_2 + n_{\frac{1}{2}} q)$$

where $S_1 = m \cdot N_f, S_2 = n \cdot (m/k) \cdot N_f, q = m/k,$ and therefore we get:

$$T_s / T_v \doteq \frac{r_{\infty v}}{r_{\infty s}} \cdot \frac{k \cdot N_f}{n \cdot N_f + n_{\frac{1}{2}}}.$$

This ratio is not usually greater than 1, and the value is both related to the degree of parallelism in the parallel computer being used (n, n1/2) and to the hardware performance $(r_{\infty s}, r_{\infty v})$, and also to the complexity of the polynomial calculations (N_f). As far as the 757 vector computer is concerned, if

$r_{\infty s} / r_{\infty v} \doteq 4, \quad n = 16, \quad k = 4, \quad n_{\frac{1}{2}} \doteq 7,$ then

$$T_s / T_v \doteq 4 \cdot \frac{4 \cdot N_f}{16 N_f + 7} = \frac{1}{1 + \frac{1}{16 N_f}} < 1$$

At this time the serial binary method is more effective. Actual computation results from the Convex C-1 vector computer show that for the problems of extracting roots from the same non-linear equation, the calculation time for the n-ary method is about 2.16 times that of the binary method (see Table 2). The reason for this is that the parallel n-ary method has more calculations than does the binary method, while for common vertical and horizontal processing vector computer systems with lower degrees of parallelism, the gain brought to this problem by making the algorithm parallel cannot make up for the overhead incurred by increasing the number of calculations. Consequently, the serial algorithm is actually superior to the parallel algorithm. This example shows that for vector computer systems having smaller values for n1/2, if there is no "compatible" parallel algorithm that corresponds to the optimum serial algorithm, then it might be more effective to use the optimum serial algorithm.

Conditions are different for array processor systems like the Illiac IV. In this case, n1/2=32, n=64, k=6, and $r_{\infty v}/r_{\infty s} = 64$, , and to solve the non-linear equation described above, using the same notation, that would be:

$$T_s/T_v \doteq 64 * k * \frac{N_f}{64N_f + 32} = \frac{6}{1 + \frac{1}{2N_f}}$$

Generally, $T_s/T_v > 1$, that is, the n-ary method is more effective than the binary method. This example shows that parallel algorithms suitable for use in array processor systems are not necessarily appropriate for vector computer systems.

IV. Conclusions

In this paper we have combined some computation examples from the 757 and the Convex C-1 vector computers to map out use of the n1/2 analytic method to study the problem of optimum parallel algorithms for solving a given problem on a particular computer system. This method is the same as the commonly used "speed-up ratio" method[7], the only difference being that we have provided a quantitative discussion, and have as well provided a theoretical basis for method selection. For vertical and horizontal processing vector computer systems with relatively small n1/2 values, the principles for choosing the optimum parallel algorithm are: 1) select a parallel algorithm where the number of calculations is compatible with the best serial algorithm; 2) among algorithms satisfying condition 1, choose those with a high degree of parallelism, that is, algorithms where the degree of parallelism is suited to the degree of parallelism of the computer being used. The selection of parallel algorithms is a very complex problem, and aside from the suitability of the algorithm, one should also consider the characteristics of the computer system together with the techniques used during execution of the algorithm. That is, things such as the storage allocation of data in memory and problems of routine branching, conditional jumps, and subroutine calls. We did not look at these in detail. We can see from the examples in this paper that there are different characteristics for

choosing optimum parallel algorithms and optimum serial algorithms, for sometimes effective serial algorithms will not necessarily lead to effective parallel algorithms. At the same time, the selection of parallel algorithms is closely related to the system structures of particular parallel computers, and parallel algorithms that are highly effective on a certain parallel system will not necessarily be highly effective on another parallel system.

Parallel computer systems are still new computer systems in China, and their appearance has provided new topics for algorithm research. At the same time, with the appearance of new types of computer systems, and especially of parallel computer systems, we must make further advances in the research and development of parallel algorithms and related topics.

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Applications Systems Development for Domestic Markets

40080120a Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 6 Apr 88 p 26

[Article by Gong Bingzheng [7895 3521 6927] of Institute No 6 of the Ministry of Electronics: "China's Microcomputer Market from the Viewpoint of the Development of Applications Systems"]

[Text] With the onset of the 1980's has come a rapid development of China's microcomputer development and production and of the dissemination of applications. The number of general purpose small computers already exceeds 200,000, while there are nearly 300,000 single-board computers, smart computers, and specialized computers. Microcomputer applications will grow more broadly and deeply with the development of China's mission of socialist reconstruction, and they will be more clearly felt in all aspects of social life. The microcomputer market in China is enormous and the potential market is even broader, for preliminary estimates predict that by 1990 there will be 500-600,000 general purpose microcomputers around, and that by the year 2000 that number will be 5-6 million, with more than 10 million specialized microcomputers.

Microcomputers of all kinds are needed by every sector of the national economy. Looking only at the situation regarding microprocessor and microcomputer products, we find there are at least the following categories:

1. single-board computers and various OEM products and intelligent components;

2. various specialized microcomputers, as for example computerized products the likes of electric tuners, bank terminals, billing machines, cash registers, programmable controllers, and controller machinery, as well as intelligent electromechanical equipment that integrates the mechanical with electronics, household appliances, intelligent instrumentation, and electronic regulator products;

3. microcomputer software: systems software, controller software, and various applications software;

4. 8, 16, and 32-bit general purpose single unit microcomputer systems, as well as work stations;

5. microcomputer Local Area Network (LAN) systems;

6. systems with multiple terminals interconnected and hierarchical network systems, all made up of microcomputers of all sizes;

7. and multiple microcomputer systems, distributed control systems, distributed processor systems, and duplex systems.

The fields of application for microcomputers will continue to expand and even at present there are more than 10,000 different uses. From the viewpoint of the end-user, there are also all kinds of microcomputer applications systems, but the basic, typical applications systems in use fall into the following groups:

1. computer-aided design systems (CAD);

2. personal computer systems for use in scientific and technical computing, business management, and small-scale numeric processing;

3. computer-aided testing systems (CAT);

4. various controlling systems and controlling devices, as well as specialized machines: (a) electromechanical equipment and numerically controlled devices, as for example machine tool numerically controlled devices; (b) industrial process control systems, as for example controller systems for the kiln furnace firing process, controllers of the rubber vulcanization process, control of the monosodium glutamate fermentation process, etc.; (c) flexible manufacturing systems and computer-aided manufacturing systems;

5. real time scheduling command systems and CI systems for industrial communications and the military sectors;

6. management information systems and economic information systems for all levels;

7. office automation systems of all kinds;

8. information retrieval systems of all kinds;

9. specialist systems for artificial intelligence;

10. business management systems for enterprises and social service units;

11. data processing systems and their terminals;

12. computer-aided teaching and diagnosis;

13. and products fitted with computers: various computers and peripheral equipment, electromechanical products, intelligent household appliances, various specialized microcomputer systems, etc.

Many of the various applications systems mentioned above may be built upon general purpose microcomputer systems, may be equipped with various applications software and general purpose and specialized peripherals, many will require LANs, and some will require on-line network systems with minicomputers, mainframes, and superminicomputers.

The microcomputer market in China is enormous, and the demands of applications in all fields are simply countless.

Take for example China's more than 10 large scale applications system projects, which is a large user of computers into which hundreds of million yuan have been invested, and where tens of thousands of microcomputers are required just for the national economic information system; the technological transformation or traditional industry requires tens of thousands of controllers (there are nearly 400,000 industrial kilns, and more than 700,000 machine tools will need transformation in rotation); enterprise management requires millions of microcomputers (industrial and mining enterprises, more than 400,000; commercial enterprises some 1.1 million, and every enterprise will need a few or dozens of microcomputers); there will be a need for hundreds of thousands or millions of special terminals for banks and financial services; and if each school will need 10 microcomputers to establish computer teaching laboratories, then for the educational system there will be a need for 2 million units just for the 200,000 middle schools alone. As for intelligent household appliances, learning machines, and toys, there will be home computers in the millions.

China's microcomputer market is characterized by the following:

In our commodity economy that is centered on a socialist planned economy, state organs and state-run enterprises are the main users of computers, so the state financial investment will be the primary source for the funds to purchase computers.

Determining factors for the market include the degree to which leaders are aware, technology policies, economic policies, and policies regarding computer applications technology and equipment; in recent years, calls by the central leaders, initiatives by the State Science and Technology, Economics, and Planning Commissions, and disseminated computer applications by organizations have stimulated the domestic computer market, and there is currently an urgent need to formulate policies on computer applications and equipment for all professions that will guide the market.

China's market is an important component of the international market, and is a market with a certain flexibility. Whether or not microcomputer products can satisfy user needs, and how performance and pricing compare will determine market competitiveness and share. The user operating environment, the urgency with which cadres at all levels require information, and the situation regarding applications skilled personnel will affect the size of the market. Faced with demands of the international and domestic marketplaces, the common tasks for science and technology circles in this country, for the manufacturing community, and for users at large are to strengthen lateral association and to hasten development of various microcomputer systems needed by the end-users, as well as microcomputer, software, and hardware products of both general and specialized uses.

Great Wall Announces New Series of IBM Clones

40080120b Beijing JISUANJI SHIJIE [CHINA COMPUTER WORLD] in Chinese No 15, 20 Apr 88 p 23

[Article by Lu Ming [4151 2494], China Computer Development Company: "New Performance, New Heights--an Introduction to Features of New Products in the Changcheng [Great Wall] Line of Microcomputers"]

[Text] On 20 April the Changcheng Group, China Computer Development Company, simultaneously unveiled five new products and systems in the domestically produced Changcheng line of microcomputers at Beijing, Shanghai, Tianjin, Chengdu, Changsa, Wuhan, Shenzhen, and Hong Kong. This was a major achievement done in only something more than 6 months by young Chinese scientific and technical personnel who enthusiastically took advantage of the excellent environment provided by the transformation and opening up of Chinese society, and who based themselves upon participation in the greater international economy. Successful development of these new products and systems also involved intensive batch production, which shows that Chinese domestically produced mainstream microcomputers have now entered a new stage through development of a product series that is represented by 32-bit machines. This is an occasion equal to the "Huai-Hai Campaign" [a decisive victory in the 1949 War of Liberation] in the development of the microcomputer industry in China, and is unprecedented in aspects of the speed of development and the scale of the products, as well as in technological innovation and financial investment.

The positioning of these five products is completely in line with the domestic and foreign microcomputer markets, and in an outstanding way they exhibit the four features that are a product line, high performance, new standards and low price.

I. The Product Line

Having a complete product line allows the Changcheng series of microcomputers to range from an ordinary model to a 32-bit super microcomputer, a sequence of models that is complete, where system configurations are more reasonable, and that confronts the demands of fields and markets of different levels.

The outstanding features of the ordinary model, the Changcheng 0520EM (Economy Monochrome), are that it is fast, has excellent Chinese character processing,

and is reasonably priced. It is especially useful for teaching, text editing, numeric input, as a bank terminal, in office automation, and as a network workstation and intelligent facsimile terminal. It is for the application level where there is a large demand for quantity, where there is not a high requirement for peripherals and system expansion, and where the lowest price is desired. It uses the Intel 8088 running at 8 MHz and is twice as fast as the IBM PC XT. The innovative Chinese language enhanced monochrome multiple grey scale display system CMGA has been integrated on the motherboard. It has a 640 X 504 resolution, can quickly display 28 rows by 40 columns of 16X16 dot matrix Chinese characters, and can automatically convert color into 16 grades of grey. It can directly run CGA color software and Hercules monochrome software, and is compatible with the Changcheng color Chinese text display standards. This therefore guarantees that the GW0520EM will have abundant applications software support. RAM can be expanded from 512K bytes to 640K bytes. External storage can be expanded from one floppy disk (360K bytes to 1.44 megabytes as desired) to two floppies or a 20-megabyte hard disk. This leaves two expansion slots, which can be used for a network controller card, a hard disk controller card, etc. The design of the ultra-thin case is attractive and different.

The low model Changcheng 0520DH (Model D, High Performance) uses a 10-MHz 8088, has 640K-bytes of RAM, operates more than twice as fast as the IBM PC XT, and uses the innovative Chinese text enhanced color display system CEGA, which integrates the original Changcheng Chinese language color display system with the EGA, as well as increasing the graphics resolution to 640 X 480. It is compatible with the IBM PS/2 VGA high-resolution graphics mode and increases the number of colors from the original 8 to 64. This system is especially useful for various small or medium scale application fields where there is a great demand for quantity.

The middle model Changchang 286B (for "Baby," indicating a small-sized 286 [AT]) uses a high-performance Intel 80286 running at 12.5 MHz and operating from 2 to 3 times faster than the IBM PC AT. It has 1 megabyte of RAM, a 30-megabyte hard disk, the CEGA Chinese text enhanced color graphics system, great expendability, and shares the same-sized new chassis structure as does the GW0520DH. It was developed for mid-scale applications fields needing high speed processing capacity.

Another middle model is the Changcheng 286EX (for 'Expanded,' referring to a larger sized 286), which has performance equal to that of the GW286B, but is fitted with a 40-megabyte high-speed disk drive, 8 expansion slots, a 200 W power supply, and a large case. It is greatly expandable for such things as large capacity hard disks, data streaming tape devices, multi-channel communications interfaces, etc. This system is especially suitable for multiple department, multiple user environments, and for complex dedicated use.

The top model, the GW386, fills a void regarding Chinese-developed 32-bit supermicrocomputers, and uses the currently most powerful 32-bit super microprocessor, the Intel 80386, which on this model is running at 16 MHz, 13.5 tmes the speed of the IBM PC ST and 3-4 times that of the IBM PC AT.

It has 2 megabytes of RAM, high-speed 32-bit access, and also uses the CEGA Chinese text enhanced color graphics system. It has a 40-megabyte high-speed hard disk and the large case. It has great potential for expendability, and is a system suitable for use in small to medium scale data processing, high-speed scientific calculating, CAD, typesetting and printing, artificial intelligence, as a network server, and in various high-level applications.

II. High Performance

Over the past year or two, the improvement in the performance of foreign microcomputers has largely been evident in the aspects of operating speed, graphics functions, internal and external storage capacity, and operating systems. The new products announced for this Changcheng line of microcomputers all use CPU's of the currently fastest operating speeds and dual-speed software switching technologies. Also, RAM access cycles may be with no wait-states, all of which doubles operating speeds. Storage capacity (for the basic configuration) is increased overall, with the GW0520DH expandable from 512K bytes to 640K bytes, while the GW386 is already at 2 megabytes. These capacities meet and exceed the capacity of directly addressable RAM in the DOS operating system, but prepare the way for the new multitasking operating system OS/2, as well as multiuser operating systems like Xenix. The new products all use either DOS 3.2 or 3.3, the newest versions, and are equipped with a high-speed hard disk disk cache, which allows for great improvement in the rate of hard disk accesses. The most important improvement is still in the development of an original Chinese text enhanced color display system, the CEGA, and the Chinese text enhanced monochrome multiple shades of grey display system, the CMGA, which are clear improvements in the capacity for handling Chinese and Western text symbols and graphics. Support from applications software is even more complete, especially because one can now run software like Windows, CAD software, and software integrating high levels of graphics in EGA and VGA modes, where that was not possible before. This has also created ideal conditions for the porting of Chinese language materials to this system and its applications software.

With hardware technology, systems software, and structural design in mind, these completely new products will accept a 3.5-inch floppy (either 720K bytes of 1.44 megabytes), and the user can easily use various 3.5-inch or 5.25-inch floppy devices. Not only does this increase storage capacities, but also greatly facilitates the linking of the Changcheng line of microcomputers with the PS/2 computers.

Analysis of the comparison table below shows that new products in the Changcheng line of microcomputers are better than the IBM PS/2 machines at least regarding operating speed, and is even more adept when it comes to handling Chinese text data. When one includes the factor that the prices are lower than those of the IBM PS/2 machines, it might be said that these new products have a very good features to price ratio.

Table comparing operating speeds and RAM between the Changcheng computers and the IBM machines

Model	CPU	Frequency	RAM	Ratio
GW0520-H	8088	4.77	512K	1.0
GW0520EM	8088	4.77/8	512K	1.8
GW0520DH	8088	4.88/10	640K	2.3
GW286B	80286	8/12.5	1 meg	7.1-9.4
GW286	80286	8	640K	6.1
GW286EX	80286	8/12.5	1 meg	7.1-9.4
GW386	80386	16	2 meg	13.5
IBM PC/XT	8088	4.77	512K	1.0
IBM PC/AT	80286	6	512K	3.4
IBM PC/AT	80286	8	640K	4.8
PS/2-30	8086	8	640K	2.1
PS/2-50	80286	10	1 meg	6.1
PS/2-60	80286	10	1 meg	6.1
PS/2-80	80386	16	2 meg	12.5

*Operating speed ratio was determined by running the internationally popular test program called SPEED.

III. New Standards

All the new products in the new series announced at this time use the most recently developed Chinese text enhanced color display system, the CEGA, and the Chinese text enhanced monochrome multiple grey shades display system, the CMGA. These two display systems are great accomplishments within domestic and foreign microcomputer Chinese and Western text symbols display technology, and there are also several technological innovations that have both advanced the technology for the handling of Chinese text display and also have conformed to development trends in international microcomputer graphics display. Whether from system structure and degree of compatibility or from the technology indexes of display speed, resolution, and color, the new series models have all greatly improved the Chinese text display systems for the Changcheng microcomputers, and they are the most advanced Chinese text graphics display systems to appear in China. They are also the newest display standards from now on for the Changcheng series of microcomputers.

The Chinese text enhanced color display system (CEGA) for this series of computers carries on the functions of high speed display of Chinese text, overlay of graphics and text, sharing of Chinese character character bases, support of extended Chinese characters, and complete CGA compatibility. There is a high degree of compatibility with the display mode of the original Changcheng line of microcomputers as far as the hardware interface is concerned, and there is complete compatibility at the BIOS interface level. At the same time, a completely EGA compatible display mode has been added (640 X 350), the number of colors has been increased from 8 to 64, and there is compatibility with the 640 X 480 high resolution graphics display mode

of the VGA. Use of a dual CRT controller technology has resolved the synchronous overlay of Chinese and Western text and graphics displays, which has resulted in the automatic recognition of, switchover to, and emulation of the various display modes. All functions have been integrated within an expansion board with its own ROM BIOS, which has kept the Changcheng special expanded graphics commands, improving the speed of plotting and at the same time allowing the Chinese text display handling functions to be completely independent from the operating system BIOS. This is convenient for operating system upgrading and the matching of various models. To support various display modes and resolutions, we have also planned to design the GW300 high resolution color display device as part of the CEGA. It will have 64 colors, and as it operates EGA software at the standard 640 X 350 resolution, it will automatically adjust for flooding. To reduce eye fatigue for users who must work in front of the screen for long periods, we have especially designed a selector switch that will change the color display into green or amber, and under that amber mode the user may select either a red or light yellow as he chooses.

After successful development of the CEGA, we ran a great deal of applications software having Chinese and Western text and graphics, which proved the very high degree of compatibility. For example, when running the Windows/386 software on the IBM PS/2-80's VGA high resolution graphics mode (640 X 480), we can directly run under CEGA; much software that runs under the 640 X 350 mode of EGA can be conveniently be upgraded to run under the 640 X 480 mode; the GWCAD and GWART high quality graphics software that ran on the original Changcheng display system can be immediately run under CEGA.

Monochrome display systems are very popular abroad. According to statistics, one-fourth of all lower quality microcomputers have a monochrome display systems.

The primary feature of the Chinese text enhanced monochrome multiple grey shades display system is that resolution is 640 X 504, and using a Chinese text ROM character base, it can accomplish high speed display of 28 lines by 40 columns of characters in a 16 X 16 matrix. The ROM character base can be shared by the host processor and the printer. It supports expanded Chinese characters, and is completely compatible with the CEGA Chinese text character mode at the hardware interface level and at the BIOS level. It is completely compatible with the Hercules monochrome mode (720 X 350), completely compatible with the CGA color display mode, has 16 shades of grey, and can automatically convert colors to shades of grey. In addition, there is a 640 X 480 monochrome high resolution graphics mode, which allows users to enjoy the results of high resolution graphics on an inexpensive monochrome monitor. Although there are various modes of display, this need not disturb the user, since the system can automatically recognize and switch over and begin emulation. All functions have been integrated onto the GW0520EM motherboard or onto an expansion board with its own ROM BIOS, both similarly supporting graphics expanded commands. This BIOS is independent of the systems BIOS, which facilitates the changing of the system BIOS, as well as fitting this to other models.

IV. Low Price

This low price is in light of high performance. Although in terms of operating speed, RAM capacity, and Chinese and Western language graphics display handling there have been great advances and improvements over previous models, there will be a significant drop in the market price for these new products in the Changcheng computer line over that of previous models, so there has been an enormous improvement in the performance to price ratio. For example, for the price of the previous GW0520C-H, one can now buy two or three GW0520EM that run faster; for the price of the previous GW286, you can now buy a GW386 super 32-bit microcomputer. The performance of the new products is not less than that of the PS/2, and they are faster, but the price is only half that of the PS/2. Even if discounting the factor of higher performance, when compared with selling prices for microcomputers imported for the domestic market, they are very competitive.

A comparison table of various microcomputer features

Model	CPU	Freq.	RAM	Floppy	Hard	Display	I/O	Chinese Text Processing
IBM PC XT	8088	4.77	512K	360K X 1	20M	CGA	expansion	weak
GW0520C-H	8088	4.77	512K	360K X 2	20M	014+015	2 ser/1 par	strong
GW0520EM	8088	8	512K	360K X 1	expan	CMGA	1 ser/2 par	strong
GW0520DH	8088	10	640K	360K X 2	20M	CEGA	2 ser/1 par	strong
PS/2-30	8088	8	640K	720K X 1	20M	CMGA	1 ser/1 par	weak
IBM PC AT	80286	6	512K	1.2M X 1 360K X 1	20M	CGA	expansion	weak
GW286	80286	8	640K	1.2M X 1 360K X 1	40M	014+015	4 ser/1 par	strong
GW286B	80286	12.5	1 meg	1.2M X 1 360K X 1	30M	CEGA	2 ser/1 par	strong
GW286EX	80286	12.5	1 meg	1.2M X 1 360K X 1	40M	CEGA	2 ser/1 par	strong
PS/2-50	80286	10	1 meg	1.44MX 1	20M	VGA	2 ser/1 par	weak
PS/2-60	80286	10	1 meg	1.44MX 1	44M	VGA	2 ser/1 par	weak
GW386	80386	16	2 meg	1.2M X 1 360K X 1	40M	CEGA	2 ser/1 par	strong
PS/2-80	80386	16/20	2 meg	1.44MX 1	75M	VGA	2 ser/1 par	weak

Table for comparing features of various display standards

Standard	Graphics Resolution	Colors	Display Mode	Chinese Text Display	Auto Mode Switching	Expanded Plotting Command Set	Graphics Text Overlay	Degree of Integration
CGA	320 X 200	4/16	CGA	none	none	none	none	single board
Hercules	720 X 350	2	Hercules	none	none	none	none	single board
EGA	320 X 200	4/16	partially w/CGA					
	640 X 350	16/64	EGA	none	none	none	none	single board
VGA	320 X 200	4/256K	partially w/CGA					
	320 X 200	256X256K	all color graphics					
	640 X 350	16/256K	partially w/EGA	none	none	none	none	single board
	640 X 480	16/256K	expan. graphics					
014+015*	320 X 200	4/16	CGA	high speed char	none	yes	yes	dual board
	640 X 450	8	expan graphics	640 X 504				
CEGA	320 X 200	4/16	CGA	high speed char				
	640 X 350	16/64	EGA	640 X 504	yes	yes	yes	single board
	640 X 480	16/64	VGA expan graphics					
CMGA	320 X 200	4/16	grey CGA	high speed char				
	640 X 480	2	expan graphics		yes	yes	none	single board
	720 X 350	2	Hercules	640 X 504				

*The 014+015 is part of the Chinese text color standard for the original Changcheng series of microcomputers.

12586/12232

Prospects for Chinese Systems Software, International Cooperation

40080120c Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 15, 20 Apr 88 p 42

[Article by Jiang Weidu [5592 4850 2629], Lu Yingzhi [0712 2503 5347], and Zhang Suqin [1728 4790 3830]: "The Prospects for International Cooperation and Product Export for China's Systems Software"]

[Text] Traditionally, by 'systems software' is meant such things as the operating system, language compiler systems, and database management systems. With the current broadening and intensifying growth of computer systems and applications, people have begun to pay special attention to the development of software support environments and support tools. As a means of improving efficiency in developing applications, the development of environments and tools is closely aligned with systems software. The internationally popular UNIX system is just such an organic composite or an operating system, a C language compiler system, and support tools. The Ada system is an object oriented program design system represented by Smalltalk, and is also a support environment for developing software. Research and development of support environments and support tools has now been included within the research and development of systems software.

The research and development of China's systems software and the support environment and tools closely related to it is one of the keys for developing computer systems and for promoting computer applications. At the same time, our computer systems and computer software is entering the international market, and one very good means for that is international cooperation with systems software and environment tools. Systems software products of advanced thinking and technology are quite attractive and competitive in international markets.

I. Our Strongpoints

At the end of the 1950's, China began research on computer systems. In the early 1960's, some scientific research organizations and higher level institutions began developing compiler systems, operating systems, and development tools. By the mid-1960's, some higher institutions had introduced teaching materials concerned with basic software such as compiler systems into scientific research classes of schools and into graduate design, and they

began training high level research personnel and design research personnel in aspects of systems software. Especially after the mid-1970's, on the basis of analyses and research of foreign systems, within China we organized and brought together a rather strong systems software development contingent (the Joint Design Group for the 100 and 200 series systems software was representative of a national conglomeration). At every link of writing teaching materials, class teaching, the teaching production line, and graduate design, higher institutions fully and systematically introduced teaching material on basic concepts and implementation technology for systems software.

With the implementation of the transformation and opening up of the early 1980's, scientific and technical exchanges were greatly increased both within the country and outside it, which has provided a stimulating factor for the development of systems software in China.

From the viewpoint of overall history, there are several advantages well worth considering regarding the basic conditions for the development of systems software in China:

1. Over the course of our 30 year computer history, our goal has always been to keep up with development trends in international systems software. Whether in basic theory or new technology directions, we have always had units and personnel corresponding to those interests who have been doing research and implementation. There has never been an interruption in the research and development of compiler systems, operating systems, and of relevant basic tools. Our computer scientific and research personnel have also been pursuing research in some new technologies and new trends in database management systems, network systems, and support software systems. And we have always maintained a high level in the basic theories and technologies of systems software.

2. As systems software has developed, China has trained a large group of systems software scientific and technical personnel who are well informed, well prepared in basics, and have strong technical capabilities, and who have thus formed the core of China's contingent of systems software research technicians.

3. In teaching systems software over a long period, our higher institutions have accumulated abundant teaching experience, and have established fairly complete teaching links and empirical links. They have arranged and published appropriate teaching materials in all aspects, categories, and levels of systems software, and have created the capability of training a large number of high level scientific and technical personnel suitable for engaging in systems software research and practice.

II. The Problems at Present

The development of computer applications software must be based upon the development of systems software. As computers penetrate every aspect of social life, applications software becomes more varied, and its development

poses more and greater demands for systems software. At present, one of the key problems in disseminating applications for computer systems in China is simply that our systems software can seldom satisfy the demands growing from applications, and there are a great number of problems in the development of systems software that require resolution.

First of all, as basic software, systems software must be highly efficient and of high quality. It is difficult to develop and takes a long time to do so, and at the same time and to a great degree it cannot directly reflect the results of applications nor economic results, for which reasons it is misunderstood by many people, who look down on it. This has become a common problem in China at present, most noticeably manifest in the lack of basic, sufficient support, both financial and material. Development funding is insufficient and it is used inappropriately. The fact that conditions regarding the computer systems for the research and development of systems software (including the computer software and hardware environments) are deficient has seriously affected the development of systems software.

Second, because of factors such as origins of financial and material resources in closely related projects, the fact that hardware must conform to domestically produced models and to the current composition and deployment of China's software technology contingent, many systems software skilled personnel have transferred to applications development. This is particularly apparent in the fact that there are few national projects involving systems software, the tasking is unclear and dispersed, the structural system of the software contingent is unreasonable, and many systems software personnel have no suitable tasking. This great waste and loss of systems software skilled personnel has affected the long term goals of systems software development and the realization of complete planning. Because domestically produced systems software is not coordinated, this has affected exports of Chinese computer systems and applications software. We should certainly learn a lesson from this.

Third, because there are no strict verification standards and means, users cannot obtain full support and guarantees when the product is used. Product development materials are unsystematic and incomplete, which poses all levels of obstacles of product maintenance. As far as software products are concerned, systems software is especially susceptible to that problem. If these imperfect, incomplete software products have no value as commodities, neither will they reap the results that commodities do, so naturally they cannot circulate in society, must less can they be export products for the international market.

III. Cooperation in Exports Will Stimulate Development

It is our opinion that we can fully utilize the advantages China has in aspects of systems software technology, and in light of the problems and insufficiencies we have in software product development, can strive to develop an exchange of technology with foreign countries and to have international cooperation. Through exports of systems software products, we can promote

the development of Chinese systems software. This can become an important path by which to build a software industry in this country:

1. From the point of view of mastering the basic concepts and levels of technology for software, we have significant real strength in that regard, but there are great gaps between us and international levels when it comes to development methods for the engineering of software. Therefore, through international technology exchanges and cooperative development, we can gradually build a scale of Chinese software development that will meet the demands for international software products. To establish a software industry in China, we must lay a foundation for our software products to enter international markets.

2. Relevant development model technologies and means are the basis for software development. We should not only carry on broad research internationally, but if some feasible advanced development methods and tool environments that have already been partially developed could bring in and attract advanced foreign technology through international technological cooperation exchanges, that help could be used to improve our development environment, consequently improving development results and quality.

3. Software production in China does not yet constitute an industry, and the great experience abroad in aspects of organizing and managing software development. International cooperation and exchanges can promote an improvement in the quality of software development organization and management personnel in China, which could lead to the organization of our software development contingent.

4. Systems software deals with the demands of the secondary development of computer systems and software, and will not be fundamentally affected by social life and economic systems. For that reason, the development of systems software can progress on its own, which is convenient for foreign technological cooperation, and can make better use of China's technological strengths.

5. Software development is knowledge intensive production, and is not restricted by raw materials and energy resources. In the situation that exists whereby the costs of software production in China are less than in other countries, if we can correctly deal with and reasonably utilize this difference, our software products can be more competitive in international markets.

In conclusion, the export of Chinese systems software is completely feasible. "Demand greater than supply" for software products and the shortage of software personnel has become a worldwide problem, even for such economically powerful countries as the United States and Japan. We can take advantage of the opportunity, and through international cooperation and exchanges use systems software as a window of opportunity to gain a place in the international software marketplace. It is our belief that in the aspects of systems software development and the export of products, as long as we pay sufficient attention, and implement more reasonable specific policies for development units and technical personnel at all levels, and adopt more positive support measure for cooperative projects, China's international cooperation in systems software and product exports are quite possible to achieve, and the future would be very bright indeed.

Speech Processing/Voice Recognition Computer System Tested

[Editorial Report] Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese of 1 June 88 carried on page 2 an announcement of the BIT Speech Processing/ Voice Recognition System perfected by China's Information Processing Research Center affiliated with the Beijing Information Technology Institute with funding from the United Nations Development Program (see brief report from Bijing XINHUA in English in FBIS-CHI-88-099, 23 May 88, p 38). The system, which underwent accreditation in Beijing on 19 May, uses key fifth-generation-computer (intelligent computer) technologies.

The article includes the following passage:

"The BIT Speech Processing System is the first domestic small and flexible integrated speech processing system which can support Chinese-English compatible speech input and output. It carries out secondary development on a Texas Instruments speech processing interface board; from upper layer software, it sets out to expand its recognition vocabulary. It consists of three parts: voice recognition, speech synthesis, and development tools.

"The voice recognition subsystem uses a hierarchical recognition method, with a design that implements Recognition Descriptive Language (RDL). According to his needs, the user can dynamically expand the system's recognition glossary. The system's design incorporates a 3-level voice data memory management technique--on-line, internal memory, and disk--with 3 levels of response speed (during testing, level 1 took less than 0.1 sec/word, level 2 less than 0.5 sec/word, and level 3 less than 1.5 sec/word). The system can take voice commands to control a DOS operating system, or can serve as a voice-controlled terminal to control a MicroVAX's operation, and comes with interfaces for user-oriented voice training, voice input editing, system maintenance, etc.

"The speech synthesis subsystem has two synthesis modes: character string and document. It solves certain problems involving homographs [i.e., characters with multiple pronunciations] and provides either 2400 or 16,000 bps speech coding for the Chinese speech base.

"The speech processing development system supports the development of applications programs for Chinese and English speech processing, and supports a development environment for various kinds of speech. The entire system can be run on a microcomputer that has an associative-style Chinese card with over 3M external memory and 512K internal memory and a Texas Instruments speech processing interface board."

Briefs

Cellular Computer for Parallel Processing--The development of the Cell Z-80 cellular computer, a major breakthrough in computer structural research based on the concept of uniting several computers like cells into one living organism, has been announced at Shanghai. This multicomputer system greatly improves parallel processing power. Engineer Xu Zhaochang [1776 5128 2490] of Shanghai Institute 615, during his advanced studies in the U.S. developed the cellular computer in cooperation with American scholars over a 4-year period. The China Patent Office has formally awarded patent rights to this "practical new model"; the U.S. and Japanese patent offices have also received patent applications for this system. Elements of the Cell Z80 unit include a Z80 CPU, a 64 x 8 memory, an I/Ointerface and multimachine windows. Ceco busses unite the structurally identical cells into the multicomputer system. The cellular computer has great market potential and can be utilized in areas of high-speed operation, parallel processing, fault tolerant technique, image processing, and network system technology, and can be used for industrial control computers, program controlled switching systems and various other computer systems. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 14, 13 Apr 88 p 1]

Galaxy Computer Network--The domestic computer network currently richest in resources, the Galaxy computer network, was recently set up and accredited at the National Defense University of Science & Technology's Electronic Computer Department. The network's backbone cable is 550 m in total length; this cable unites over 20 heterogenous computers--including a Galaxy 100MIPS[super]computer, a Galaxy superminicomputer, the emulator, a CAD system, and an IBM-PC--into the network. This large-scale, powerful network will be used for data communications, resource sharing, and distributed processing. Data transmission rate is 20Mbps. High and low speed interfaces are provided for long-distance interconnection to other computers. The National Defense University has also developed a series of software packages for augmenting or expanding its functions, such as remote station software, network monitoring software, network aid, teaching software, testing software, etc. The establishment of the Galaxy computer network will provide a modernized network environment to the university's teaching, research, management, and library sections, as well as greatly raise the usage rate and practical scope of the 100MIPS Galaxy computer. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 14, 13 Apr 88 p 1]

Another Galaxy Supercomputer Installed--Another Chinese-made 100MIPS Galaxy supercomputer is now operational at the Southwest Computing Center in Mianyang, Sichuan Province. The bilateral meeting to hand over the computer [from the manufacturing party to the receiving party] was officially held on 21 April. On the afternoon of 22 April, representatives of both sides formally signed the agreement. Assistant Director Jiang Xueguo [3068 1331 0948] of the General Office of the State Council's Leading Group for Development of Electronics Industry, leaders of various ministries and commissions under the State Council, various academic committee members of the Chinese Academy of Sciences, and others attended the meeting and the signing ceremony. [Excerpts] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 18 May 88 p 1]

Software System for Engineering Development--At a press conference held on 4 May, Institute 6 of the Ministry of Electronics Industry announced the development of a Chinese-English compatible version of the Sun 32-bit microcomputer engineering workstation software system. This key project in the state's Seventh 5-Year Plan has produced China's Largest micro-computer engineering development system, which can be run on Sun's workstation or on domestically manufactured units. The project was led by Institute 6 with the participation and cooperation of the Chinese Academy of Sciences' Software Institute. Run under the UNIX operating system, the support systems include graphics (GKS, or Graphics Kernel System), Chinese-character X windows (based on MIT's network transmission window "X-Window V.10"), database, and networking. Other software systems to be Sinicized in the near future include Ingres database, X/News Window, and compilers in the C, Fortran, and Pascal languages. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 18 May 88 p 1]

Tianjin Adopts Computer Development Plan--According to the national electronic computer development program, the Ministry of Electronics Industry and Tianjin City have adopted a start-up plan to speed development of the computer industry based on the fourth-generation-computer plan (the "Taiji Plan") which has been explored for the past year. Both parties have designated Tianjin's Zhonghuan Computer Company as the nucleus of the plan. Utilizing Tianjin's advantageous investment climate, several business arrangements such as joint ventures, cooperative agreements, and foreign sole proprietorships will be encouraged; a computer industry development, production, and technical service center will be gradually established. Annual production goals for 1990 are as follows: 50,000 single board systems, 20,000 microcomputers, 300 microcomputers, 110,000 monitors, and 2000 bank terminals. Complete sets of peripherals--printers, network equipment, power sources, keyboards, etc.--will be domestically produced. Total investment is forecast at 150 million yuan, output value (after implementation of the plan) at 750 million yuan, taxes at 138 million yuan, and foreign exchange earned at US$9 million. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 25 May 88 p 1]

Air Defense Computer Network--The Tianjin City Civil Air Defense Office and Tianjin University--with the support of the Office of the city's Leading Group for Development of Electronics Industry and the city's

Science Council--have jointly developed a Tianjin Municipal Air Defense Command and Administration Computer Network System, now undergoing accreditation in Tianjin. This system solves the problem of interconnecting different types of computers, and uses a PDP-11/73 as its central node computer, with nine IBM-PC/XTs organized via the node computer into a star network. The system's real time capabilities are strong, with a transmission time of less than 3 seconds for urgent alarm signals. In addition to functions such as file transfer, screen dialog, text editing, daily log printing, and menu prompting, the network has an air information plotting subsystem consisting of a 1024 x 768 color monitor and electronic plotting board. Also provided are real time listing, and automatic tracking, smoothing, and [curve] fitting of flight paths. Following a nuclear attack or a chemical weapons attack, the system can rapidly carry out various kinds of data estimates, and instantaneously display data on casualties, infected areas, and the distribution of toxic materials spread by wind via the graphics mode on the monitor screens. The system has AUTOCAD drafting functions and Chinese-character functions, for automatic drafting and revision of forecast charts for air raids. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 20, 25 May 88 p 2]

Minicomputer CAD Graphics Workstation--The S-8/20 CAD graphics workstation developed by Institute 706 of the Ministry of Aviation and Astronautics Industry underwent accreditation on 17 May. Observers agreed that this is the first domestic CAD graphics workstation developed on a Chinese-made minicomputer and that its performance has reached international standards of the mid eighties. The workstation comes with a tape drive, graphics monitor, digitized displays, a drafting machine, and a color copier. The software system uses FORTRAN language compiling and can handle basic packages such as PLOT-10/4014, 10/4114, and 10/IGL for two-dimensional and three-dimensional interactive drafting. This product has practical value in furthering the development of computer aided manufacturing. [Summary] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21, 1 Jun 88 p 1]

Minisupercomputer for Petroleum Industry--The China National Instrument Import & Export Corporation signed a contract a few days in Hong Kong with the Geotech Corporation for the latter to provide a minisupercomputer network system to the Beijing Petroleum Exploration & Development Institute. This is to include one of the latest Convex C-120 minisupercomputers, several Sun and Apollo workstations, and various graphical designs to complete a local area network system. The system is to be used for digital oil deposit simulation, to provide a scientific basis for rational petroleum extraction. [Text] [40080164 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21, 1 June 88 p 2]

New Fuzzy Intelligent Controller (FIC)

40100030 Harbin HARBIN GONGYE DAXUE XUEBAO [JOURNAL OF HARBIN INSTITUTE OF TECHNOLOGY] in English No 2, Apr 88 pp 122-124

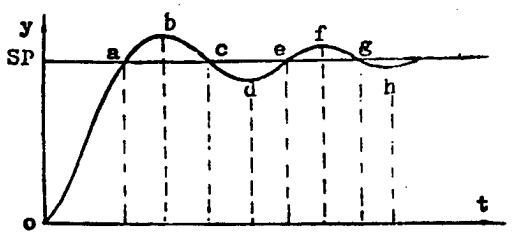
[Article by Li Shiyong [2621 1102 0516] (Department of Control Engineering)
(Received 10 Dec 87)

[Text] Key Words: Artificial intelligence; computer control, fuzzy controller; intelligent controller, nonlinear system.

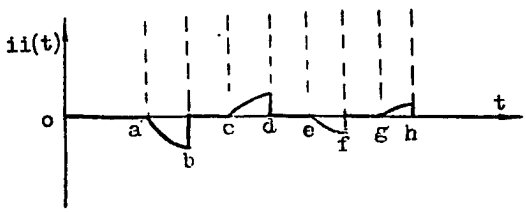
It is well known that in many situations the integral control to be used to improve the steady-state performance of feedback control systems is often taken into consideration. The integral action has been applied to modelling human "memory" function to some extent. It always "remembers" the information about the process errors and the changes of errors in feedback control systems. From the viewpoint of control the information provided by the integral action is sometimes useful, and sometimes useless.

The integral action described above is illustrated in Fig. 1. It is observed from Fig. 1 (b) that the human intelligent integral has "remembered" the information useful for control, and "forgotten" the information useless to control. That is to say, such an integral method can be used to avoid "integral-saturation." Therefore, we are considering the problem of introducing the human intelligent integral action into a fuzzy controller to reduce steady-state errors.

The analytical description of the control rule for a conventional fuzzy controller without considering the integrating function was given in [1]. According to the quantization method of the fuzzy control rule, the author considers further the action of the intelligent integral. The control rule of the FIC can be written as follows.



(a) Response of a second-order system to a step input



(b) Human intelligent integral

Fig. 1

$$U = \begin{cases} INT[\alpha E + (1-\alpha)C] & (E \cdot C < 0 \quad or \quad E = 0) \\ INT\left[\beta E + \gamma C + (1-\beta-\gamma)\sum_{i=1}^{k} E_i\right] & (E \cdot C > 0 \quad or \quad C = 0,\ E \neq 0) \end{cases} \qquad (1)$$

where E, C are an error and a change of the error respectively, α, β and γ are weighting coefficients, and $\alpha, \beta, \gamma \in (0,1)$. Here different values of α, β and γ represent different degrees of weighting for the error and the change of the error respectively. For this reason, the control rules of the FIC may be regulated with these weighting coefficients.

In order to examine the performance of the FIC for typical controlled plants and to make comparisons between the performance indexes under the FIC and FC (Fuzzy Controller), and between those under the FIC and the PID, a series of digital simulation experiments were performed.

For the purpose of simplicity, the simulation experiments are assumed to be a single-input and single-output system. The typical controlled plants with time delay are of second order. For example, the transfer function is given as

$$G(s) = \frac{ke^{-\tau s}}{(T_1 s + 1)(T_2 s + 1)} \qquad (2)$$

Fig. 2 shows the responses to a unit step input for the plant controlled by the FIC, the FC and the PID respectively. The parameters of the FIC, the FC and the PID were chosen carefully so as to give a good set of responses.

It is interesting to compare the above responses in Fig. 2. It is clear that the performance indexes of the FIC control for the same controlled plant are superior to those of the FC and the PID control. For example, the setting time is short, the output response exhibits no overshoots, and the steady-state error is very small.

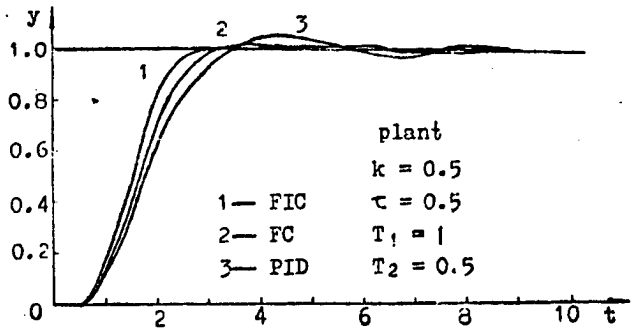


Fig. 2 Step response curves for the FIC, FC, PID

The method of intelligent integration of the "fuzzy value" of error signals has the advantage of considering simultaneously both dynamic and steady performance, and the digital simulation shows that this method is practicable.

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/08309

Enhancement of Photon Anti-Bunching--Interference of Two Light Beams After Two-Photon Absorption

40090091a Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 3, Mar 88 pp 193-199

[Article by He Linsheng [0149 2651 3932] of Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences: "Enhancement of Photon Anti-Bunching--Interference of Two Light Beams After Two-Photon Absorption"; manuscript received 2 November 1986, revised 9 January 1987]

[Abstract] The anti-bunching effect (ABE) is a unique quantum phenomenon in radiation. It not only has great importance in theory but also can be used to minimize fluctuation in an optical field. Anti-bunching in a two-photon absorption is particularly attractive because the effect is enhanced with time or distance.

Bandilla and Ritz first introduced a scheme to enhance photon anti-bunching by destructive interference. However, numerical computation showed that the scheme is not satisfactory because the statistical nature of the optical field in photon anti-bunching is different than that of a coherent optical field.

This paper presents another scheme which enhances the photon anti-bunching effect by a factor of over 10^{12} using the destructive interference between two light beams. A coherent light beam is split into two. Each beam then passes through a two-photon absorber to alter its statistical characteristics independently. The initial phase difference of the two beams is adjusted to create a destructive interference to enhance the photon anti-bunching effect.

Theoretical equations for this scheme were derived. Statistical photon number under short term conditions was also obtained. It shows that in the range of $180° \geq \varphi \geq 135°$, the photon anti-bunching effect can be enhanced by 10^{12}. Since the range is fairly wide, this phenomenon ought to be observed experimentally.

12553/6091

Forced Oscillation Model of Optical Bistability

40090091b Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 3, Mar 88 pp 205-211

[Article by Ou Fa [2962 4099], Wu Tingwan [0702 1656 8001], and Zhang Xiaodong [1728 2556 2639] of South China Institute of Technology: "Forced Oscillation Model of Optical Bistability"; manuscript received 3 January 1987, revised 3 August 1987]

[Abstract] A laser field can be considered as a self-contained oscillation that obeys the Van der Pol equation. The output field of an optical bistability system can be viewed as a forced vibration driven by the incident field. The problem is to set up this non-linear equation. In this paper, a new optical bistability (OB) model is presented. Based on the concept of mean field approximation, slow envelop approximation and adiabatic approximation, the OB system is regarded as a "black box," as shown in the following figure. In analogy to the theory of non-linear vibration, different optical bistability systems (including different working media and cavities) can be approximately described by the forced vibration equation. The parameters involved are all measurable and can be experimentally obtained.

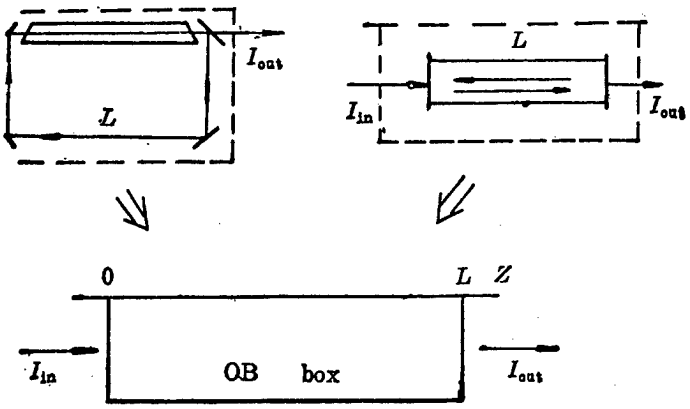


Figure 1. Box model of optical bistable system

Steady state and transient solutions of the equation were obtained. This model is verified by applying the results to two examples reported in the literature. In both cases the critical slow varying effect is apparent.

The transient optical bistability functions in the two extreme cases of pure absorption and pure dispersion are more or less similar and are independent of the cavity. This is in agreement with our conclusions. In addition, the dynamic equation in this paper is valid. However, there may not be an analytical solution. Other problems such as the extension of the model, stability of the solution and ability to handle a hybrid phenomenon are still to be investigated.

12553/6091

Ultrafine Structure of XeCl Excimer Laser Spectrum

40090091c Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 3, Mar 88 pp 253-256

[Article by Lou Qihong [2869 4388 3163] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences: "Ultrafine Structure of XeCl Excimer Laser Spectrum"; manuscript received 20 January 1987, revised 25 June 1987]

[Abstract] The emission spectra of XeF, XeCl and KrF have been studied in detail. Because the lower energy state X of the XeCl excimer is a weak bonding state, the emission spectrum associated with the transition XeCl(B-X) is continuous. This makes the quantitative analysis of the spectrum complicated.

The author observed the ultrafine structure associated with a vibrational transition in the excimer laser spectrum. A theoretical analysis was carried out based on a vibration-rotation coupling model. An expression for energy levels is obtained. The spectral lines are calculated and the energy levels are shown in the following figure. The most possible explanation is that the ultrafine structure is related to the rotational structure of the XeCl excimer spectrum.

[Figure on following page]

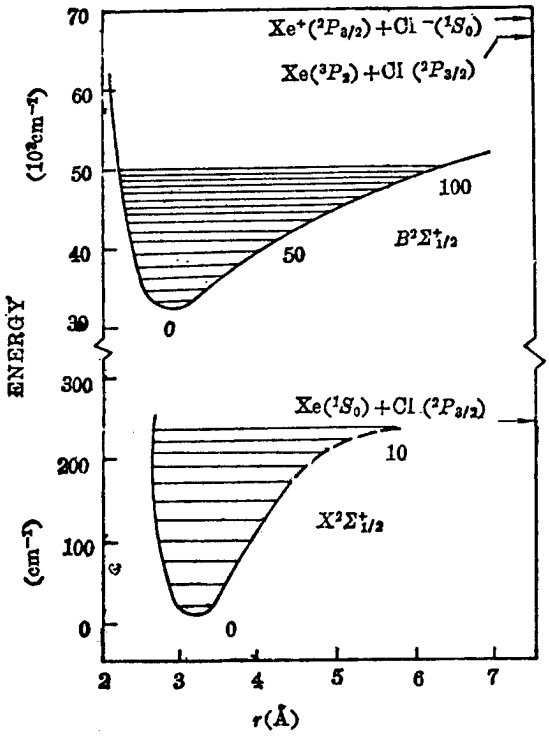


Figure 1. Potential curves of $B^2\Sigma_{1/2}$ and $X^2\Sigma_{1/2}$ of the XeCl excimer

12553/6091

Investigation of the Gain of Copper Vapor Laser

40090091d Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 3, Mar 88 pp 257-260

[Article by Yin Xianhua [1438 2009 5478], Liang Baogen [2733 1405 2407], Tao Yongxiang [7118 3057 4387], Cui Jianli [1508 0256 0500], and Chen Lifei [7115 5461 5481] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences: "Investigation of the Gain of Copper Vapor Laser"; manuscript received 6 April 1987, revised 11 May 1987]

[Abstract] The gain of a gas phase laser is an important parameter in the design of a laser amplifier. This paper reports a study on the gain of the 5106 A line of the copper vapor laser.

The Frantz-Nodvik model was used in this work because of the finite pulse width (20~30 ns) of the copper vapor laser. The following equation is derived:

$$g \cdot E_S = 1/2\ h\nu \cdot \Delta$$

where g is the small signal gain coefficient, E_S is the saturation energy density and $\Delta = 5.1 \times 10^{12} \cdot cm^{-3}$ is the inverted particle density.

The experimental setup is shown in the following figure. The dependence of the laser output energy density on the energy density of the amplifier input signal is obtained by least square fit. It was found that $g = 0.2\ cm^{-1}$ and $E_S = 22.3\ \mu J \cdot cm^{-2}$. It was also found that the relative power output in the saturated gain region depends on the delay error of the trigger signal. In practice, the ratio of the amplifier light signal to the superradiation light is an important parameter to judge the quality of the light from the amplifier. It is affected by the light signal, synchronization between the oscillator and the amplifier and the diameter of the incident beam.

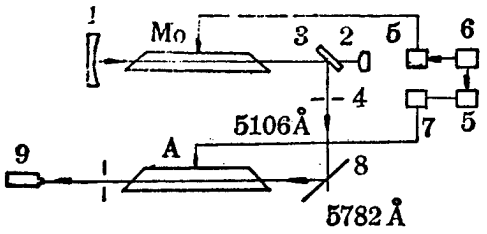


Figure 1. Schematic diagram of the apparatus

M_o--a laser master oscillator; A--an amplifier; 1, 2, 3--mirrors of unstable resonator; 4--apertures of diameter; 5--pulse generator; 6--master generator; 7--time interval; 8--optical filter; 9--power meter

12553/6091

EXPERIMENTAL STUDY ON CHARACTERISTICS OF DISTRIBUTED FEEDBACK LASER

40090103a Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 302-307

[English abstract of article by Wang Runwen [3769 3387 2429], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The radiation spectrum, temporary dynamic process and wavelength tunable characteristics of the distributed feedback laser pumped by a Q-switched and frequency doubled Nd:YAG laser have been studied. Two new effects, including autoswitching, which narrows the output pulsewidth of distributed feedback laser light, and double pulse generation, with the pumping power being higher than the threshold, have been found. The experimental results and analysis are presented in detail.

9717

SUPERNARROW RESONANT EFFECT OF COHERENT EXCITATION ATOMS USING MODE-LOCKED LASER

40090103b Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 312-318

[English abstract of article by He Linsheng [0149 2651 3932] of Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] A theoretical scheme of coherent excitation atoms is proposed to explain the essence of supernarrow resonant effects produced when the mode-locked laser pulse train excites the atoms. The expressions of the atomic density operator $\rho_A(t)$ and spectra signals are derived and the relevant curves are given. The new results for the supernarrow resonant effects are also predicted. The theoretical scheme can be extended to apply to multiphoton processes.

9717

THEORETICAL ANALYSIS OF PRISM-LEAKY WAVEGUIDE COUPLER

40090103c Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 337-343

[English abstract of article by Jin Feng [6855 6912] of Changchun Institute of Physics, Chinese Academy of Sciences]

[Text] According to the multi-beam interference principle, the prism-leaky waveguide coupler has been analyzed theoretically and compared with the prism-waveguide coupler. Criteria for using these two kinds of couplers properly are also given. The results of analysis show that the prism-leaky waveguide coupler can be used for measuring parameters of thin films and input-output coupling of the optical waveguide when substantially operated under strong coupling conditions. For weak coupling, the author's results agree with Tien and Ulrich's theoretical analyses.

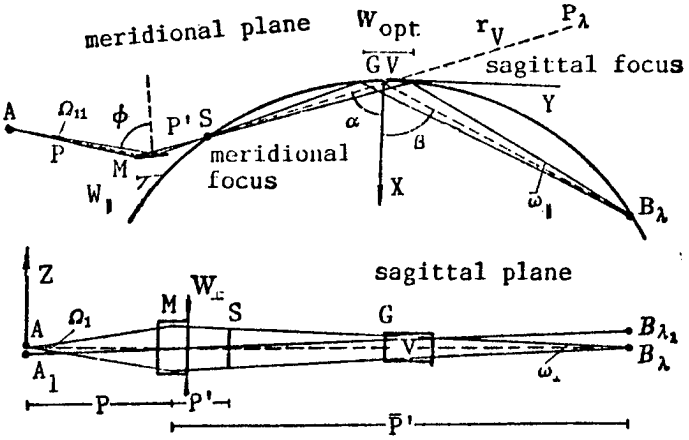
9717

IMAGING X-RAY SOURCE USING TOROIDAL MIRROR

40090103d Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 348-353

[English abstract of article by Feng Xianping [7458 6343 1627], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The authors present a detailed theoretical analysis of X-ray optics and point out that it is possible to image an X-ray source in a grazing incidence manner. Using a toroidal mirror and a concave mirror, a picture was taken of the X-ray source from laser produced plasma, and the results were consistent with those of theoretical analysis. The experimental results show that this method is applicable to X-ray optics.



M—toroidal mirror; *S*—focal line of meridional plane; *B*—focal spot of system; *V*—concave mirror; *A*—source

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PHASE NOISE OF SEMICONDUCTOR LASER DUE TO EXTERNAL OPTICAL FEEDBACK

40090103e Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 368-373

[English abstract of article by Ye Jiaxiong [0673 0857 7160] of the Department of Optical Engineering, Huazhong University of Science and Technology, Wuhan, Hubei]

[Text] Phase noise in the semiconductor laser due to external optical feedback is investigated theoretically. The theoretical analysis introduces a feedback coupling rate K and linearized rate equations. The authors also derives the expersion of phase noise power spectrum density of the semiconductor laser. It is shown that the phase noise spectrum density shifts periodically with the length of the external cavity and the peak value of the power spectrum density varies considerably with the feedback coupling rate.

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COUPLING BETWEEN TWO DOUBLY CLADDING SINGLE MODE FIBERS

40090103f Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 8 No 4, Apr 88 pp 379-384

[English abstract of article by Chen Zhihao [7115 2535 3185] of the Physics Department, Fujian Teachers University; Yao Huihai [1202 1979 3189] of Shanghai University of Science and Technology, Shanghai Optical Fiber Technique and Modern Communications Research Institute]

[Text] An accurate analytical expression of the coupling coefficient between two parallel doubly cladding single mode fibers is given in this paper. The coupling coefficients, as a function of the normalized frequency parameter V, are calculated for fibers with raised, matched and depressed inner cladding indices. The coupling coefficients, as a function of normalized distance D/a, are also given with different Vs. The formula can be used to compute the coupling coefficients for x-polarized modes as well as the further coupling of y-polarized modes. It can also be used to analyze the coupling between two fibers with large refractive index differences, as well as the polarization characteristics of optical fiber couplers.

9717

MEASUREMENT OF STRESSES IN SILICON WAFER WITH INFRARED PHOTOELASTIC METHOD

40090107a Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 7A No 2, Apr 88 pp 109-112

[English abstract of article by Qin Ganming [6009 3927 2494], et al., of the Department of Physics, South China Institute of Technology]

[Text] An infrared photoelastic system for measuring stresses in silicon wafers and its measurement method are presented in this paper. An experiment involving exerting pressure on a silicon wafer is conducted on a model of a simply supported beam subjected to four concentration forces. The result of stress measurement basically agrees with the theoretical results. In addition, stresses induced in silicon wafers during the simulated processing of semiconductor devices are measured.

9717

USEFUL ALGORITHM FOR INFRARED TARGET RECOGNITION

40090107b Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 7A No 2, Apr 88 pp 121-124

[English abstract of article by He Bin [0149 3453], et al., of Northwest Telecommunications Engineering Institute]

[Text] The characteristics of infrared target images obtained from a practical infrared imaging system are analyzed. A method for calculating the invariant moments of target images is presented using the projection functions of the targets. Based on the theoretical analysis and computer simulation results, the possibility of using two invariant moments to describe the target characteristics is discussed.

9717

RETRIEVAL OF ATMOSPHERIC TEMPERATURE STRUCTURE FROM NOAA-9 SATELLITE

40090107c Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 7A No 2, Apr 88 pp 125-130

[English abstract of article by Dong Chaohua [5516 6389 5478], et al., of the Satellite Meteorological Center, National Meteorological Bureau]

[Text] In this paper, a statistical regression with matching algorithm is described to retrieve the atmospheric temperature structure from the NOAA-9 satellite. The calculated temperatures are verified through comparison with radiosondes over the China region. The study shows that the root-mean-square (rms) difference is about 2.3°C over the middle and low latitude areas, and about 3.0°C over the higher latitude areas. The largest differences are near the ground and in the tropopause region, particularly over areas with complicated topography.

9717

FREQUENCY CORRELATION FUNCTION OF QUIVERING OPTICAL IMAGES OF LIGHT BEAMS PROPAGATING IN TURBULENT ATMOSPHERE

40090107d Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 7A No 2, Apr 88 pp 131-137

[English abstract of article by Zhang Yixin [1728 6654 2450] of the Department of Opto-electrical Technology, East China Institute of Technology]

[Text] The frequency correlation problem of the quivering of optical images formed in a receiving system is analyzed. The source is a light beam propagating in a turbulent atmosphere. The double frequency correlation function of optical images of light beams in a turbulent atmosphere is derived. The analytical formulas of the quivering frequency correlation function of optical images of quasi-spherical waves and plane waves, propagating in a weakly turbulent fluctuation region, as well as the wavelengths of the optical sources corresponding to the maximum quivering of optical images, are obtained.

9717

INVESTIGATION OF TEMPERATURE DEPENDENCE OF SPECTRAL QUANTUM EFFICIENCY $\eta(\lambda)$ OF InSb(PV) INFRARED DETECTORS

40090107e Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 7A No 2, Apr 88 pp 139-144

[English abstract of article by Zhang Yanxin [1728 1693 1823], et al., of the Institute of Modern Optics, Nankai University; Song Qingxi [1345 1987 3556] of the Department of Electronics, Nankai University]

[Text] The spectral responsivity of InSb(PV) detectors measured at temperatures from 4.2 K to 77 K is reported. It is shown that, for the wavelength range from 3.6 μm to 4.8 μm, the spectral quantum efficiency $\eta(\lambda)$ of the detectors being measured does not simply decrease as the temperature decreases, but has a peak feature. The temperature for the peak is dependent on the material, structure and design of the detectors, and is also dependent on the wavelength and background radiation conditions. The physical mechanism of the results is described qualitatively.

9717

SATURATION EFFECT IN OPTICALLY PUMPED FAR-INFRARED LASERS

40090109a Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 15 No 6, 20 Jun 88 pp 321-325

[English abstract of article by Wang Changxin [3769 7022 6580], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The dressed-atom approach is used to study the saturation effect of an optically pumped three-level system. The samal signal gain, containing two different saturation factors, has been obtained and can be conveniently applied to analyze different saturation behaviors of the Raman and line-center transitions in optically pumped far-infrared lasers.

9717

SUFFICIENT, NECESSARY CONDITIONS FOR DYNAMIC STABLE TELESCOPIC-RESONATORS

40090109b Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 15 No 6, 20 Jun 88 pp 326-331

[English abstract of article by Lü Baida [0712 4102 6671] of the Department of Physics, Sichuan University, Chengdu; Wei Guanghui [7614 0342 6540] of the Department of Optics, Beijing Institute of Technology]

[Text] Using g'- and g*-parameter equivalent resonators and expressing the beam radius on the output mirror by the normalized refractive power D_n and parameter A, the sufficient and necessary conditions for dynamic stable telescopic-resonators in TEM_{00}-mode operation are derived for the first time. Analytical expressions of the normalized refractive power D_n, thermal focal length f, and g_1^*, g_2^* parameters of dynamic stable telescopic-resonators are deduced respectively. Results obtained in this work can easily be generalized to include multi-element resonators with many internal lenses (one of which is a thermal lens).

9717

NOVEL ELECTRONIC EQUIPMENT FOR STABILIZING OUTPUT POWER OF LOW POWER He-Ne LASER, RESTRAINING ITS OUTPUT NOISE

40090109c Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 15 No 6, 20 Jun 88 pp 336-340

[English abstract of article by Xu Shunchao [1776 7311 3390], et al., of Shanghai Institute of Laser Technology]

[Text] This paper presents some novel electronic equipment with which laser beam stability exceeding 0.5 percent can be obtained, and its output noise, compared with that obtained using an ordinary stabilized current power source, can be reduced by about 20 dB in the acoustic frequency range.

9717

APERTURE-AVERAGING EFFECTS FOR COLLIMATED BEAM IN FOLDED PATH

40090109d Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 15 No 6, 20 Jun 88 pp 350-354

[English abstract of article by Song Zhengfang [1345 2973 2455], et al., of Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Hefei]

[Text] The correlation function of log amplitude fluctuations of a wave reflected from a plane target in a turbulent atmosphere is derived for a weak fluctuation region and is used to evaluate the aperture-averaging effect. The results show that the correlation length of the collimated beam propagating in a folded path is smaller than that of the wave propagating the same total length in the forward direction. However, they agree in order of magnitude with the radius of the first Fresnel zone. From this, the aperture averaging factor in a straight path is greater than that in a folded path, signifying that the turbulence-induced intensity fluctuation can be reduced with a reflector. The agreement of the authors' experimental results with their theoretical prediction is excellent.

9717

QUIVERING FREQUENCY CORRELATION OF OPTICAL IMAGES OF LASER LIGHT PROPAGATING IN TURBULENT MEDIUM

40090109e Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese
Vol 15 No 6, 20 Jun 88 pp 355-358

[English abstract of article by Zhang Yixin [1728 6654 2450] of the Department of Optical and Electrical Technology, East China Institute of Technology, Nanjing]

[Text] The quivering frequency correlation function of optical images formed by a receiving system is obtained using the Markov approximation. The source is a laser beam propagating in a turbulent atmosphere. An analytical form of the frequency correlation function of the optical image quivers of laser beams propagating in the weak beam turbulent broadening region is also obtained, and the problem of optical image quivers which depend on the wavelength of the optical source is discussed.

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CHEMICAL REACTIONS IN PLASMA INITIATED BY LASER IN HYDROCARBON COMPOUNDS

40090109f Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 15 No 6, 20 Jun 88 pp 363-367

[English abstract of article by Xu Jiren [1776 4480 0088], et al., of the Institute of Physics, Chinese Academy of Sciences, Beijing]

[Text] The authors report the experimental set-up and results of the chemical reaction in plasma initiated by the TEA CO_2 laser in methane and ethane which have been changed to actylene and ethylene. In methane, the degree of conversion to actylene is 93 percent, while in ethane, the conversion to actylene and ethylene is 81.5 percent and 19.3 percent, respectively. In a mixture of methane and ethane, the degree of conversion from ethane to ethylene is as high as 37 percent. A brief discussion of the chemical reaction process in the focal region is given.

9717

Effect of Defect Clustering on VLSI Yield Statistics and Statistical Parameters as a Function of Chip Area

40090110a Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 9 No 3, May 88 pp 244-254

[English abstract of article by Zhang Zhongxuan [1728 6988 1357] and Li Zhijian [2621 1807 1017], Institute of Microelectronics, Tsinghua University, Beijing]

[Text] Based on negative binomial distribution and analysis of two statistical experiment results, a statistical model of the cluster parameter is given as a function of chip area for VLSI yield; defect distribution is also given. During the model derivation, the correlation between the quadrants caused by the defect clustering effect is considered. The agreement of the theoretical model with the given experiments is satisfactory. (Received 26 Jun 87.)

/9274

Studies on X-Ray Interference Fringes in GaAlAs/GaAs Epitaxial Layers

40090110b Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 9 No 3, May 88 pp 262-268

[English abstract of article by Gao Dachao [7559 1129 6389], et al, Changchun Institute of Physics, Chinese Academy of Sciences, Changchun]

[Text] X-ray interference fringes caused by polylaminates have been observed during the growth of GaAlAs/GaAs epitaxial layers by use of MBE and LPE methods. The interference fringes can be recorded and the fringe images can be taken by use of the X-ray double crystal goniometer. The results are discussed in the case of bending epitaxial GaAlAs/GaAs samples. The bending radius of the epitaxial sample can be calculated from the inter-space of the interference fringes of film image, and the thickness of different layers can be calculated from oscillating periods of their fringes in the rocking curves. (Received 20 Jan 87.)

/9274

Improved Model and Numerical Simulation for Two-Dimensional Ion Implantation

40090110c Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 9 No 3, May 88 pp 269-277

[English abstract of article by Xu Chenxi [1776 2525 2569], et al, Microelectronics Institute, Fudan University, Shanghai]

[Text] A new two-dimensional ion implantation model is presented. The two-dimensional distribution of the implanted impurity near an arbitrary shaped mask edge is described by two half-Gaussian profiles or a modified Pearson IV distribution in the vertical direction and by a complementary error function in the lateral direction. The different shopping powers of the various mask materials for a multi-layer mask have been considered. Using this model, an implantation process simulator has been developed which can continuously calculate the impurity profile for several times with different energy, dose and impurity. In the calculated results, the effects of the various mask edges have also been taken into account. It is shown that our simulators both in accuracy and function are much better than previous ones. (Received 26 Jan 87.)

/9274

Deep Level Investigation of N-Doped FZ Si Crystals

40090110d Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 9 No 3, May 88 pp 312-314

[English abstract of article by Luan Hongfa [2940 3163 4099], et al, Institute of Semiconductors, Chinese Academy of Sciences, Beijing]

[Text] The deep levels related to nitrogen in N-doped FZ Si crystals were studied by DLTS [deep level transient spectroscopy]. A level located at E_C-0.57 eV related to nitrogen was observed besides the two levels, E_C-0.20 eV and E_C-0.28 eV, observed by others. After annealing at 400°C for 0.5 hr., the three levels vanished and three new levels related to nitrogen were formed. They were located at E_C-0.17 eV, E_C-0.37 eV and E_C-0.50 eV. Their annealing behavior was studied. (Received 30 Dec 86.)

/9274

BRIEFS

ION-BEAM EPITAXY MACHINE--The development of a low-energy dual ion-beam experimental machine for ion-beam thin film deposition research--a project first proposed in 1979 by China's noted semiconductor materials specialist, Professor Lin Lanying [2651 5695 5391] from the Scientific Council of the Chinese Academy of Sciences (CAS)--has been unveiled at Beijing after eight years of struggle by the CAS's Institute of Semiconductors, Plants 4503 and 708 of the Ministry of Electronics Industry, and Institute 401 of the Ministry of Nuclear Industry. The machine has undergone national-level accreditation and has been turned over to the CAS Institute of Semiconductors. Observers agreed that its development will provide a useful tool for semiconductor thin film technology and materials science, and will open a new path for development and production of three-dimensional ICs and high-speed components. The performance of this state-of-the-art system, which consists of two independent ion beams, meets all design norms. It has a current density of 100 microamps per square cm, an ion energy of several tens to several hundreds of electron volts, is designed for separable mass numbers up to 208, and has a target chamber with a vacuum of 10^{-8} torr. [Text] [40080153 Beijing DIANZI SHICHANG [ELECTRONICS MARKET] in Chinese 28 Apr 88 p 1]

Japan To Provide Beijing Institute With Fiber Optic Telephone System

43063034 Tokyo OPTRONICS in Japanese No 3, Mar 88 p 63

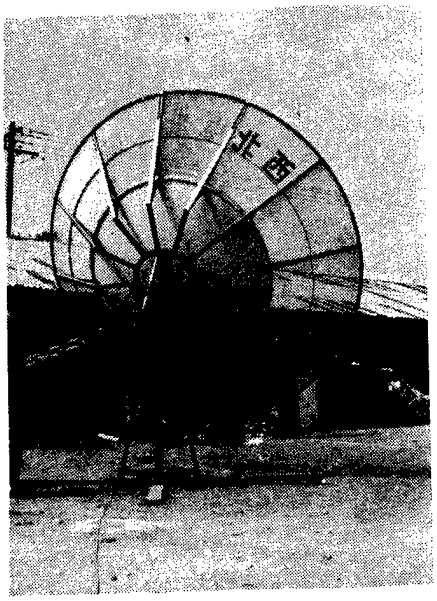
[Summary] Japan's Optical Industrial Technology Promotion Society, which has been making an effort to popularize optical technology applications systems in other countries, is planning to set up a fiber optic telephone system in the Beijing Posts and Telecommuni-ations Institute, an organization responsible for training executives for the telecommunications and postal networks in the PRC. The fiber optic telephone system will connect the headquarters of the institute with other buildings on the grounds, and it will be possible to obtain an evaluation of the system while it is being used for technical instruction. Project costs for the system, which is scheduled for completion in JFY 1988, will be something over 100 million yen, although the Chinese will be able to use it free of charge.

6335

3.5-METER SATELLITE TV ANTENNA

40080152b Beijing DIANZI SHICHANG [ELECTRONICS MARKET] in Chinese 28 Apr 88 p 2

[Summary] The WJ-3 3.5-meter satellite television receive only (TVRO) antenna manufactured by the factory of the Xi'an College of Electronic Science & Technology has been certified at ministry level. This high-precision antenna has a gain of 40.5-41dB (4GHz), a standing wave ratio less than or equal to 1.184, and a circular polarization axial ratio less than or equal to 1.25. Its structure is supported by a strong mesh of splines; the entire unit weighs 150 kg. It is superior not only to the domestic 3-meter tabular antenna, but also to imported tabular antennas. Its main performance indicators meet the SJ2772 standard issued by MEI, and it costs less than 10,000 yuan. Suitable for universities, training centers, high schools and middle schools, industrial and mineral enterprises, and the like, it can pick up instructional programs broadcast via foreign satellites as well as those broadcast via [China] Central Television.



/7310

BRIEFS

Fiber-Optic Production Center--A state-approved fiber-optic communications production center will be built in Tianjin by the Tianjin Optoelectronic Communications Company and the Electronic Instrument Joint Import/Export Company with fiber-optic communications terminal production technology and equipment imported from the Federal Republic of Germany's Standard Elektrik Lorenz (SEL). With this equipment fully utilized, the companies will be able to manufacture a total of 18 types of products--including fiber-optic communications terminals, optical repeaters, and digital multiplexing equipment--with a quality comparable to that of advanced international products. By 1991, the companies will be able to produce 600 opto-electronic terminals yearly; over 75 percent of China's optical terminals will then be domestically produced. Moreover, these terminals will be marketed worldwide. [Text] [40080152a Beijing DIANZI SHICHANG [ELECTRONICS MARKET] in Chinese 28 Apr 88 p 1]

Signal Processors Meet International Standards--Laboratory 10 of the Chinese Academy of Sciences' Institute of Acoustics has put out a line of six high-speed multifunctional signal processing systems in the TMS320 series that meet international standards. These signal processors, designed for an IBM-PC, provide real-time digital processing. Replacing imported products, the systems can save greatly on foreign exchange. In addition, funds realized from the sale of these products will permit the institute to continue its basic research without state investment. Already established at the institute is a microcomputer software laboratory. [Summary] [40080167 Beijing GUANGMING RIBAO in Chinese 14 June 88 p 2]

State-of-the-Art Microwave Achievements--Two state-of-the-art microwave development--a high-repeatability ultra-short-pulse semiconductor laser and an ultrahigh-voltage carrier data transmission machine--recently underwent ministry-level certification in Xi'an. The former product, perfected by several instructors in the Technical Physics Department at Xi'an College of Electronic Science & Technology, is not only technically advanced and reliable in performance, but also low in cost--only one-fifth that of the comparable foreign product. The development of the latter product will provide an important communications aid to railroad, coal, metallurgy, electric power, and other authorities for modernizing their scientific management. [Text] [40080167 Beijing GUANGMING RIBAO in Chinese 14 June 88 p 1]

Telephone-Line Digital Image Transmission--The "telephone-line digital static image transmission system" prototype jointly developed by the Nanchang Television Plant in Jiangxi Province and by Zhongshan University in Guangdong Province was recently certified in Nanchang. Its main technical indicators have reached international standards of the eighties. Principal applications of this system, which can send and receive images via long-distance terminals

and can display four different fields of images simultaneously, are for monitoring, transmission, control, and interconnention in areas of national defense, public security, hydrology, meteorology, medicine, archiving, and modern industry. The product will be batch produced beginning in the latter half of this year. [Text] [40080167 Beijing DIANZI SHICHANG [ELECTRONICS MARKET] in Chinese 26 May 88 p 2]

High-Resolution TV Control System--A new generation television system--a high-resolution TV control system--designed by the Chinese Academy of Sciences' Institute of Electronics was recently perfected and put into batch production at the Taicang [1132 0221] East China Radio Plant in Suzhou, Jiangsu Province. The system consists of a [TV] camera unit, a control unit, and a monitor. The camera tube uses the XQ1440 tube manufactured by Philips Japan, which has a high target surface sensitivity, low dark current, and an 800-TVL limiting resolution. The entire system has video polarity conversion and maintains excellent grey-level characteristics and arbitrary adjustment functions, and comes equipped with a shadow suppression circuit. This portable system has applications for tracking, monitoring, image processing, and long-range control in areas of medical treatment, national defense, public security, education, and scientific research. The selling price is only one third that of similar foreign products. During testing, all nine indicators--including scanning [sweeping], signal transmission, and synchronous stability--met design requirements. Trials in Beijing and elsewhere demonstrated its stable performance, reliable quality, and high definition. [Summary] [40080167 Beijing DIANZI SHICHANG [ELECTRONICS MARKET] in Chinese 26 May 88 p 2]

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